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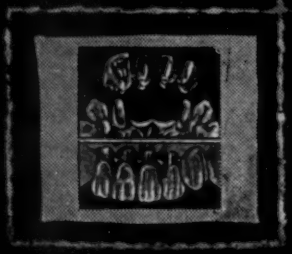

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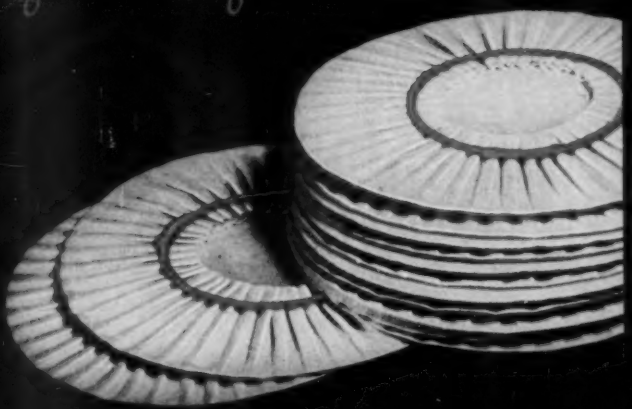

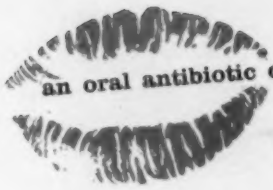


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# Histologic effects of silver nitrate on human dentin and pulp

*Harold R. Englander,* D.D.S., M.P.H., Great Lakes, Ill.; Verda E. James,† D.D.S., and Maury Massler,‡ D.D.S., M.S., Chicago*

Ammoniacal silver nitrate has been widely used by dentists since Percy Howe[1] advocated the sterilization of infected dentin in deep caries lesions rather than mechanical removal by bur or spoon with possible exposure and injury to the pulp. Although many other drugs (thymol, phenol, creosol, creosote, benzalkonium chloride and so forth)[2-7] have also been used with the hope of sterilizing infected dentin, silver nitrate remains one of the most frequently used medicaments for cavity sterilization.

In order to determine whether the use of silver nitrate is based on rational principles, it is necessary to answer two questions: Is silver nitrate an effective sterilizing agent? Is silver nitrate damaging to pulp tissue?

## REVIEW OF THE LITERATURE

*Sterilizing Action of Silver Nitrate* • A review of the literature reveals that the effectiveness of silver nitrate as a sterilizing agent may be questioned. Seltzer[3-5] applied silver nitrate for three minutes to teeth *in vivo* and took bacteriologic cultures from one week to a year later. He indicated that silver nitrate had only limited sterilizing action. Hardwick[6] found that silver nitrate in the concentrated

The opinions and assertions contained herein are those of the authors and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

*Lieutenant Commander, Dental Corps, Dental Research Facility, U. S. Naval Training Center.

†Assistant professor of histology, College of Dentistry, University of Illinois.

‡Professor of pedodontics, College of Dentistry, University of Illinois.

1. Howe, P. R. A method of sterilizing, and at the same time impregnating with a metal, affected dentinal tissue. D. Cosmos 59:891 Sept. 1917.

2. Day, H. W. Thymol in cavity sterilization. J.A.D.A. 31:605 May 1944.

3. Seltzer, S. Comparative value of various medicaments in cavity sterilization. J.A.D.A. 28:1844 Nov. 1941.

4. Seltzer, S. Effective duration of some agents used for dentin sterilization. J. D. Res. 21:115 April 1942.

5. Seltzer, S. Effectiveness of antibacterial agents used in cavity sterilization. J. D. Res. 21:269 June 1942.

6. Hardwick, J. L. Sterilization of carious dentine. Proc. Roy. Soc. Med., Sec. Odont. 42:815 Oct. 1949.

7. Muntz, J. A.; Dorfman, A., and Stephan, R. M. In vitro studies on sterilization of carious dentin. I. Evaluation of germicides. J.A.D.A. 30:1893 Dec. 1943.

aqueous or ammoniacal forms was effective only moderately but worked better than the other agents when tested *in vitro*.

Müntz, Dorfman and Stephan,[7] using blocks of carious dentin *in vitro*, demonstrated that the effectiveness of a saturated solution of silver nitrate as a sterilizing agent was proportional to its depth of penetration. Applications of silver nitrate for three minutes produced limited penetration and sterilization to depths of at least 0.25 mm. A ten minute application was more effective and the depth of sterilization was increased to 0.75 mm. in most cases.

Klein and Knutson,[8] and James and Parfitt[9] applied silver nitrate to the proximal and occlusal surfaces of permanent first molars *in vivo* to prevent or arrest incipient enamel caries. They could observe no protective action against caries on the treated molars when compared to the untreated molars on the opposite side. However, Schultz-Haudt, Taylor and Brudevold[10] excavated the proximal carious lesions of deciduous teeth and made the regions self-cleansing by slicing with a disk before applying a silver nitrate solution. They showed that recurrence of caries on the treated surfaces was less than on the untreated surfaces.

*Penetration of Silver Nitrate* • There have been many claims (empirical) that silver nitrate has a self-limiting action and stains only carious dentin but does not affect vital dentin.

Zander[11] demonstrated that sound dentin was also penetrated by silver nitrate. He showed that the penetration into sound dentin varied with different teeth and also in different regions of the same specimen. Zander and Smith,[12] studying both ground and decalcified sections of dog and human teeth which had been treated with silver nitrate before removal, found that the silver nitrate did penetrate "calcific barriers." No difference existed in the penetration of silver nitrate through the dentin over sound or degenerating pulps or in pulpless teeth. The penetration was the same when studied in ground or decalcified sections.

Zander and Burrill[13] studied the effect on penetration of varying the length of time between the application of the silver nitrate and its precipitation by eugenol. They also investigated the effect of varying the time interval between silver nitrate precipitation and extraction of the tooth. It was found that the length of time intervening between application of silver nitrate and precipitation by eugenol did not influence the depth of penetration. However, the depth of penetration increased as the time interval between precipitation and extraction increased. Eventually the silver nitrate was observed to reach the pulp. Repeated applications of silver nitrate did not vary the depth of penetration. Hardwick[6] demonstrated that silver nitrate could penetrate nearly to the pulpal surface within 15 minutes after application. He stated that he rarely observed silver particles within the pulp.

Zander[11] divided the silver nitrate penetration into three zones: an outer zone of heavy deposit; an intermediate zone of lighter deposit, and a deeper zone of heavy deposit. He did not attempt to explain this phenomenon.

Hardwick[6] described three zones in carious cavities treated with silver nitrate as follows: a superficial zone of black staining up to 1 mm. in depth; an inter-

8. Klein, H., and Knutson, J. W. Studies on dental caries. XIII. Effect of ammoniacal silver nitrate on caries in the first permanent molar. J.A.D.A. 29:1420 Aug. 1942.

9. James, P. M. C., and Parfitt, G. J. Clinical note on the use of silver nitrate in the prevention of fissure caries in newly erupted first permanent molars. Brit. D. J. 96:35 Jan. 19, 1954.

10. Schultz-Haudt, S.; Taylor, R. G., and Brudevold, F. Effect of topical application of silver nitrate on dentin. J. D. Res. 32:681 Oct. 1953.

11. Zander, H. A. Use of silver nitrate in the treatment of caries. J.A.D.A. 28:1260 Aug. 1941.

12. Zander, H. A., and Smith, H. W. Penetration of silver nitrate into dentin. II. J. D. Res. 24:121 June-Aug. 1945.

13. Zander, H. A., and Burrill, D. Y. Penetration of silver nitrate solution into dentin. J. D. Res. 22:85 April 1943.

mediate layer of brown staining structureless material, and a deep zone with coarse particles of silver. These granules became larger the more deeply they penetrated.

*Effects of Silver Nitrate on Vital Pulp* • Despite the known caustic action of silver nitrate, most investigations indicate little or no damage to the pulp when the silver nitrate was applied to sound or carious dentin in even moderately deep cavities.

Zander and Burrill[13] studied the pulp reactions to silver nitrate in both dog and human teeth. They showed the histologic responses of the pulp to silver nitrate in three human teeth. One human tooth, extracted one week after application, showed a normal pulp under a shallow cavity to which silver nitrate had been applied for one minute followed by a five minute application of eugenol. Another tooth, extracted one week after the application, showed a slight hemorrhage beneath the cavity in which silver nitrate was left for 24 hours before being precipitated by eugenol. In both instances, the black granules of precipitated silver did not reach the pulp. The third tooth was examined histologically one month after silver nitrate application and showed that the precipitate reached the pulp where some reaction could be found. Examination of an untreated control tooth demonstrated that there was some reaction of the pulp in the vicinity of the odontoblasts beneath the cavity. Zander and Burrill[13] felt that this was the result of the cavity preparation and was similar to the reactions observed in the teeth treated with silver nitrate. They concluded that silver nitrate does not disturb the pulp severely.

Hardwick[6] prepared cavities in a dozen human teeth, applied silver nitrate for two minutes and extracted the teeth from 15 minutes to 15 days after application. He demonstrated a disorganization of the odontoblastic layer beneath the areas of precipitated silver. Pulpal reactions to silver nitrate varied from slight changes to complete disorganization of the odontoblastic layer, round cell infiltration and hemorrhage. In spite of these findings, he stated that only slight pulp reactions occurred after the application of silver nitrate to exposed vital dentin.

Perreault, Massler and Schour[14] applied silver nitrate in various forms to cavities prepared in incisors of the albino rat. All the pulps showed severe destruction, including abscess formation and total destruction of pulpal elements. The effects increased with the depth of the cavity preparation.

As the dentin of the rat incisor is thinner and more permeable, and the pulp is more sensitive than in the human, the reaction in the rat pulp seemed to be much more severe than the mild pulpal responses reported by other investigators on human material. In view of the widespread use of silver nitrate (in spite of its limited sterilizing action on infected dentin), it was decided that the reactions of the dental pulp to a standard, prolonged application of ammoniacal silver nitrate needed further clarification. Although silver nitrate is frequently applied in deep cavities with potential or actual small pulpal exposures, a report of a histologic investigation describing the effects of applying ammoniacal silver nitrate directly to exposed vital pulp tissue could not be found.

It was the purpose of this investigation to gather more information relative to the effects of silver nitrate on vital human pulp tissue and to describe the reactions of this drug on sound and carious dentin.

## MATERIAL

All the teeth selected for this study were from naval personnel ranging in age from

14. Perreault, J. G.; Massler, M., and Schour, I. Reaction of odontoblasts to medicaments placed in cavity preparations in rat incisors. J.A.D.A. 52:533 May 1956.

18 to 28 years. The great majority of these teeth, 26, had been ordered extracted because of large carious exposures with severe destruction of the crown. A few teeth which were scheduled to be removed for prosthetic reasons and third molars in severe malocclusion were also utilized.

## METHOD

The application of Howe's ammoniacal silver nitrate (pH-10.0) was standardized.[15] The ammoniacal silver nitrate was applied either to exposed pulp tissue or carious cavities for five minutes. Ammoniacal silver nitrate (Howe's) was applied to the carious dentin of five teeth and to the caries-exposed pulps of ten teeth. The dentin floor of all cavities and the exposed pulps were covered with a layer of zinc oxide and eugenol paste. All teeth then were sealed with an additional layer consisting of zinc oxide and eugenol paste to which zinc acetate (5 per cent) had been added as an accelerator in powder form to the zinc oxide. This second layer was carefully placed so that it did not contact the dentin floor or exposed pulp. All teeth were extracted for histologic preparation from 9 to 32 days later.

An additional series of ten teeth was studied primarily to determine the effects of silver nitrate on dentin and pulp within a short period of time after application. None of these teeth contained pulp exposures after cavity preparation. The standard application of ammoniacal silver nitrate followed by eugenol precipitation was made on carious cavities in five upper third molars. Three of these teeth were extracted within five minutes after application and two after about an hour. Ammoniacal silver nitrate not followed by eugenol was applied for five minutes to cavities in one third molar and for ten minutes in two others. These teeth were extracted ten minutes later. A saturated aqueous solution of silver nitrate was applied for ten minutes to two teeth which were extracted within 20 minutes after application.

Aqueous silver nitrate was applied to the exposed pulp of one tooth. This tooth was extracted 21 days later for histologic analysis.

Complete histories were taken on each individual including the history of pain and the physical appearance (color and depth) of the dentin. When a pulpal exposure was present, the size of the exposure, quality of hemorrhage and appearance of the blood clot was recorded. Preoperative and pre-extraction roentgenograms were taken and histories of pulpal pain were noted again before the extraction. All extracted teeth were immediately fixed in 10 per cent Formalin. The first 15 specimens of long duration (extracted 9 to 32 days after application) were decalcified in 5 per cent nitric acid. The subsequent series of 11 teeth were demineralized by means of ethylene diamine tetracetic acid. All teeth were embedded in celloidin and serial sections (10 to 12 microns in thickness) were cut and stained with hematoxylin and eosin (H and E) and with Mallory's triple connective tissue stain.

Various types of controls were utilized in analyzing the effects of ammoniacal silver nitrate on human vital pulp tissue. Untreated carious and noncarious teeth were also examined histologically. In some teeth a large cavity was prepared and the dentin floor divided into two parts; one portion of the cavity floor was treated with silver nitrate and the remainder served as the untreated control.

## OBSERVATIONS

*Reactions of Carious and Noncarious Dentin To Silver Nitrate* • The following four layers could be distinguished in dentin treated with silver nitrate (Fig. 1):

15. Gordon, S. M., and Shand, E. W. Ammoniacal silver nitrate. J.A.D.A. 20:530 March 1933.

1. A thin, superficial layer of black precipitate on the surface of the dentin. This layer consisted of free silver precipitated by the eugenol. The precipitate was on, rather than in, the dentin and indicated that the eugenol acted on the surface of the dentin only or penetrated the dentin only superficially.

2. A layer of carious dentin which stained brown. This was probably the result of the reduction of the silver nitrate by the carious matrix to brown free colloidal silver or, perhaps, a combination of the silver nitrate with the altered available protein. The deepest border of this brown staining mass was irregular, clearly outlining the advancing carious lesion into the underlying dentinal tubules and matrix.

Carious dentin which was not subjected to silver nitrate treatment stained a deep purple with hematoxylin and eosin. Carious dentin treated with silver nitrate stained a deep brown and did not take the purple stain of the H and E. Therefore it was concluded that the brown staining was a specific result of the silver nitrate.

3. An intermediate zone relatively free of silver staining. This zone may represent a zone of reduced dentinal vitality (metamorphosed or sclerotic dentin?). This zone coincides with the region in which the tubular contents have degenerated in advance of the carious lesion.

4. A deeper zone containing large black globules of reduced silver particles. These were observed deep within the vital dentinal tubules and within the pulp cells.

Black silver particles could be found within the pulpal cells of all five non-exposed specimens which were extracted from 17 to 32 days after the standard application of silver nitrate. However, in teeth extracted within an hour after application of silver nitrate, there was usually (in 8 out of 10 specimens) only a superficial penetration of silver particles within the dentinal tubules. This confirms the findings of Zander and Burrill[13] that silver nitrate or silver particles continue to penetrate through the dentinal tubules long after being precipitated by eugenol. It is evident that the depth of penetration by silver increases with survival time. Presumably, all teeth treated *in vivo* would eventually show silver particles within the pulp.

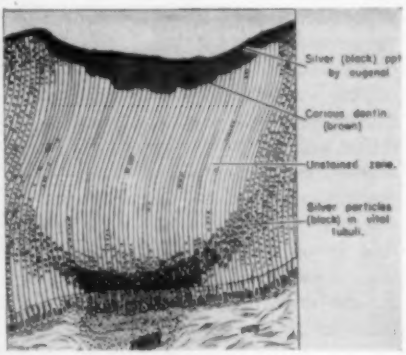



Fig. 1 • Reactions of human dentin and pulp to silver nitrate

In 8 of the 10 specimens extracted within one hour after the application of silver nitrate, penetration was only superficial. However, in two specimens, both extracted five minutes after the application of silver nitrate (for 5 and 10 minutes respectively), silver particles were observed to penetrate the entire thickness of dentin and enter the pulp tissue itself. The reason for the much greater permeability of the dentin in these two instances is not known.

The silver particles penetrated the carious dentin and into the pulp of all 11 teeth exposed by caries. In these instances the precipitate occurred only in the region where vital tubules still persisted and on the surface of the blood clot immediately under the exposure. The black precipitate within the vital tubules and on the blood clot resembled the black precipitate observed on the surface caused by the eugenol. It was obvious that the

silver nitrate must have been reduced by the protoplasmic contents of the tubules or the cells.

The penetration of the silver particles was not limited to primary dentin. Reduced silver particles were also observed to cross over into secondary dentin and eventually into the pulp. In every case where silver was observed in the pulp, it had traveled down the protoplasm of the odontoblastic process to the cell body in the odontoblastic layer. The silver particles tended to concentrate at the junction between primary and secondary dentin and at the pulpal dentinal membrane; that is, at junctions where high concentrations of protoplasm occur.

*Effects of Ammoniacal Silver Nitrate on Nonexposed Pulps* • Black silver particles could be found within the pulp in all five of the nonexposed specimens extracted from 17 to 32 days after the application of the silver nitrate. The pulps beneath carious dentin to which ammoniacal silver nitrate was applied revealed inflammatory changes under the area of application. There was destruction and atrophy of the odontoblastic layer beneath the area of application of silver nitrate and many of the degenerating odontoblasts contained silver particles. In regions where the accumulation of silver particles was dense, hemorrhage and edema could be observed within the pulp. Similar changes were absent from carious teeth not treated with silver nitrate.

A history of pain could not be elicited from any of the subjects at any time after the application of silver nitrate. The inflammation did not extend into the deeper portions of pulp. The pulp below the zone of disturbance was normal in all instances.

Figure 2 is a decalcified section (Mallory) of upper right second bicuspid from a patient 18 years old. The tooth was extracted 17 days after the application of ammoniacal silver nitrate to the carious dentin. No exposure was noted clinically or microscopically. The pulp under the area of silver nitrate application was destroyed. Silver particles can be observed penetrating into the pulp. This section shows the penetration of silver particles through a dentinal tubule to the pulpodentinal junction. Silver particles may be seen within a degenerating pulpal cell, and deposited around capillaries (Fig. 3).

Eight teeth with deep carious lesions were examined histologically without being treated with silver nitrate. These untreated controls showed little or no evidence of the pulpal disturbances which invariably were present in the teeth treated with silver nitrate.

*Effects of Ammoniacal Silver Nitrate on Exposed Pulp Tissue* • Ten teeth with clinically visible pulp exposures caused by caries were treated with ammoniacal silver nitrate (Howe's) for five minutes followed by the application of eugenol for five minutes. The carious and noncarious dentin in these teeth showed the same zoning as previously described. One tooth was treated with saturated aqueous silver nitrate. This showed a picture similar to that seen in the teeth treated with ammoniacal silver nitrate.

In the region of the exposure the following reactions were observed:

1. A large superficial hemorrhage always was present in the portion immediately under the exposure. The surface of the blood clot contained large black globules of free silver. The appearance of these black globules was the same as those seen within the vital protoplasm of tubules or cells. The deeper portions of the blood clot contained no black precipitate of silver.

2. A broad band of inflamed pulp lay immediately under the blood clot. This band of inflammation also was seen in the untreated exposed pulps covered with zinc oxide and eugenol for an equivalent period of time. However, the inflammatory band seemed to be wider in teeth

Fig. 2 • Mallory-stained section magnified 650×, nonexposure. Penetration of silver may be seen approaching the pulp. Silver particles may be observed within degenerating pulpal cell

that were treated with silver nitrate.

3. The pulp subjacent to the band of inflammation was normal.

*Reaction in Exposed and Nonexposed Teeth* • In a number of sections it was apparent that the pulp under a thin layer of dentin treated with silver nitrate was more severely inflamed than the pulp beneath an actual exposure treated with silver nitrate. Apparently, the blood clot protected the pulp against the action of the silver nitrate more effectively than did the thin layer of dentin. The silver nitrate was precipitated more completely by the blood than by the odontoblastic processes in the dentin. This may explain the relatively slight amount of pulpal injury observed under pulp exposures. Only three of the 11 teeth in this series had a history of transient thermal sensitivity during the period between silver nitrate application and extraction. Pain was severe in only one instance.

*Untreated Controls* • Eleven teeth which had clinically visible pulp exposures were used as controls. These were not treated

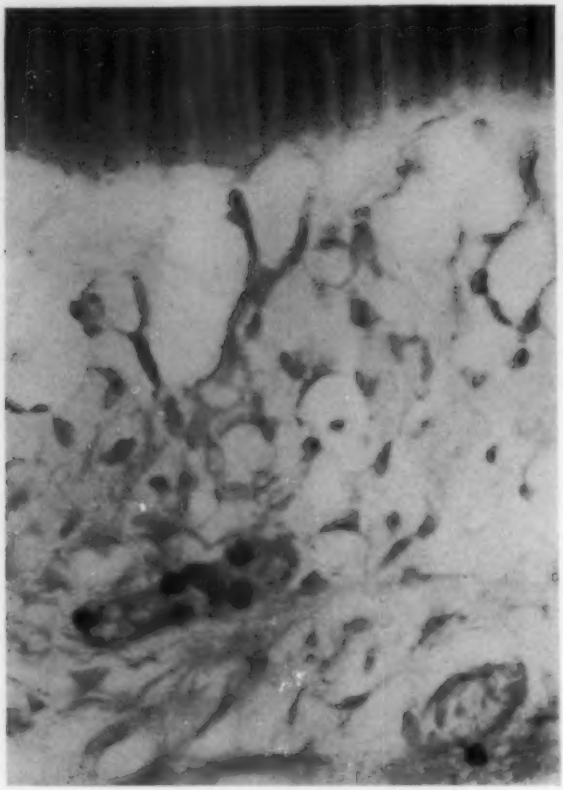


Fig. 3 • Section of pulp magnified 650×. Silver particles are evident around blood vessels

with silver nitrate but were sealed with zinc oxide and eugenol and extracted from 1 to 30 days later for histologic examination. The pulpal reactions were similar to the teeth treated with silver nitrate with the exception that the zone of inflammation subjacent to the hemorrhage was much narrower.

## DISCUSSION

Although silver nitrate penetrated to the pulp in only 2 of 10 teeth which were extracted within an hour after application, it reached the pulp in all the teeth without pulp exposures which were extracted 17 to 32 days later. It appears clear that the black precipitates of silver particles eventually reach the pulp regardless of the length of time of application. This confirms previous findings by Zander and Burrill.[13] The silver particles may reach the pulp almost immediately or only after some longer time, depending on the permeability of the dentin. Hardwick was able to discern penetration to the pulp within 15 minutes, but Zander and Burrill[13] showed that the precipitate usually did not reach the pulp within one week. They showed that the silver particles did

reach the pulp after one month in all instances.

Four distinct layers were found in the dentin treated with silver nitrate (ammoniacal or plain) and reduced by eugenol:

1. A very narrow, superficial layer of free silver precipitated on the surface of the dentin by eugenol. It is clear that the eugenol did not limit the penetration of the silver nitrate and is responsible only for the superficial precipitation of free silver on the surface of the dentin. The black "silver mirror layer" seen by the clinician after reduction by eugenol was not within the dentin but lay on the surface of the dentin.

The silver nitrate penetrated quickly and deeply into the dentinal tubules almost immediately after its application with accompanying injury to the odontoblastic processes and degenerative changes in the cell bodies of the odontoblasts. This occurred whether eugenol was used or not. Silver nitrate is not a self-limiting drug but its limitation is caused by living protoplasm. The silver nitrate was not limited to the carious layer.

2. Layer of dark brown carious dentin. The layer of carious dentin was stained a deep brown with the silver nitrate. At present, the best explanation for the formation of this brown stain is that the carious process alters (depolymerizes or denatures) the protein of the dentin matrix. This depolymerized or denatured protein either combines with the silver to form a dark brown silver proteinate or reduces the silver ions to colloidal silver which also appears brown.

3. The silver-free zone. Between the carious dentin and the black precipitate of silver deep within the vital tubules, there was an unstained region relatively free of silver particles. This silver-free zone may represent a portion of degenerating tubular material. The dentinal tubules undergoing protective metamorphosis or becoming sclerotic in advance of the carious lesion, may present a modified type of protein which does not react with the silver nitrate. It is also possible of course that the silver ions may have reacted with the phosphate or chloride ions in this region to produce a white, nonvisible precipitate.

4. Zone of black, precipitated silver particles. Black particles of free silver were present within the vital tubules of the sound dentin well in advance of the carious lesion. They tended to concentrate at the boundary between the primary and secondary dentin. This corroborates the findings of Zander and Smith.

It is not likely that the Formalin used in fixation was responsible for the reduction of the silver complex ion to free silver. The reduced silver tended to accumulate rather specifically in regions rich in vital protoplasm.

*Reactions of Pulp Tissue Beneath Dentin Treated With Silver Nitrate* • Contrary to previous reports[6, 13] this study revealed disruption of the odontoblasts with increasing degrees of inflammation and edema of the pulp as the silver nitrate came closer to the pulp. If sufficient time were allowed to elapse between application and extraction, black silver particles always were found within the pulp. This disturbance of the pulp always was limited to the region in which the silver had penetrated into the pulp. The pulp under untreated spots always was normal.

*Reactions of Exposed Vital Pulp Tissue to Silver Nitrate* • When silver nitrate was applied over actual pulp exposures, free silver was precipitated by the hemorrhagic mass under the exposure. This effectively prevented the further penetration by the silver nitrate as evidenced by normal pulp tissue under the inflammatory zone normally found surrounding the region of hemorrhage. The failure to injure the pulp severely when silver nitrate has been applied directly to exposed pulp tissue is thus explicable. In these instances the silver nitrate was

reduced immediately and rendered innocuous by the blood clot.

It is interesting and clinically significant to note that more pulpal damage is caused by the application of silver nitrate to sound dentin than to carious exposures. Sound dentin apparently does not precipitate as much of the silver ion as does the blood, and so permits the silver nitrate to penetrate more deeply and thus to irritate the pulp more severely.

## SUMMARY AND CONCLUSIONS

Twenty-six carious human teeth with and without pulpal exposures were subjected to a standardized series of applications with silver nitrate, ammoniacal and plain. Histologic examination revealed the following:

1. Ammoniacal silver nitrate was not self-limiting. It penetrated through sound tubular dentin, both primary and secondary, as well as through carious dentin.
2. Silver nitrate stained the sound and the carious dentin differentially. Carious dentin stained a deep brown. The degenerating tubules under the carious region did not stain at all. The contents of the deeper, vital dentinal tubules precipitated the silver ions as black particles of free silver.
3. Damage to the pulp occurred under sound dentin which was subjected to silver nitrate applications. The black particles of silver eventually reached the pulp.
4. There was a strong tendency by the pulp to localize the injury caused by the silver nitrate.
5. There was considerably less damage under silver nitrate applied directly to exposed pulp than when the solution was applied to sound dentin. This was probably because the blood of the underlying hemorrhagic region completely precipitated the silver nitrate, limiting its action and preventing its further penetration.
6. In view of the limited sterilizing action by silver nitrate and its potentially injurious action to the contents of vital dentinal tubules and the odontoblasts as well as the pulp itself, the value of its continued use on an empirical basis is questioned.

*Education and Encouragement* • Our schools must encourage the brains, for our world needs brains. We can no longer be content with mediocrity, with the second rate. There is nothing undemocratic about this. To develop an intellectual elite is no more undemocratic than to develop an athletic elite or a journalistic elite. We must learn to take brains in our stride, as we do expertness on the football field, the basketball floor, the office or workshop, and the newsroom. *Henry Steele Commager. Our Schools and the Climate of Freedom.*

# Photoelastic stress analysis of buccolingual sections of Class II cavity restorations

*Willard F. Guard, D.D.S., M.S., Denver; Donald C. Haack, M.S., and Ralph L. Ireland, D.D.S., M.S., Lincoln, Neb.*

Previous investigations by Lampshire[1] and Haskins[2] showed that if certain mechanical principles are incorporated in the Class II cavity preparation, they can alter significantly the resistance of the silver amalgam restoration to fracture and affect the stress pattern produced in the restoration. Haskins'[2] photoelastic study of stress distribution was concerned with mesial-distal sections of the Class II cavity restoration. There remained the question of how the buccolingual cross section of the Class II cavity should be shaped in order to make the most efficient use of the restorative material and produce the lowest possible stresses in the restoration. The basic purpose of this investigation, therefore, was to study the distribution of stress on the occlusal step portion of the Class II restoration as a result of different cavity designs.

It was immediately apparent that an investigation of the stresses on buccolingual planes by two-dimensional photoelastic methods would introduce a problem not encountered in Haskins' research. The problem arises from the fact that all mesiodistal sections of the Class II restoration are geometrically similar, but buccolingual sections experience an abrupt change in shape at the axial wall. This abrupt change of shape may affect the distribution of stress in the buccolingual sections on the occlusal step as far removed from the axial wall as a distance equal to the width of the occlusal isthmus (de St. Venant's principle).[3] Thus, the results of this study are limited to a qualitative investigation of the stress in the buccolingual section and to a quantitative comparison of stresses on sections removed at least the width of the occlusal isthmus from the axial wall. This limitation, however, is largely compensated for by the fact that buccolingual sections of the occlusal step portions of Class II restorations are similar in shape to axial sections of Class I restorations placed in the occlusal region. The results of this study, therefore, can be applied to Class I restorations in the occlusal region as well as to Class II restorations.

In this investigation, buccolingual sections of five different Class II cavity forms, with shallow and deep pulpal

From the department of pedodontics, College of Dentistry, and Engineering Mechanics, College of Engineering, University of Nebraska.

The data presented in this paper were taken from a thesis submitted by Willard F. Guard in partial fulfillment of the requirements for the degree of Master of Science in Dentistry in the graduate college of the University of Nebraska. This investigation was supported by the Medical Research and Development Board, Office of the Surgeon General, Department of the Army, under Contract No. DA-49-007-ND-283.

1. Lampshire, E. L. Relation of cavity form to failure of silver amalgam restorations in primary molar teeth. Thesis, University of Nebraska Library, 1950.

2. Haskins, R. C.; Haack, D. C., and Ireland, R. L. Study of stress pattern variations in Class II cavity restorations as a result of different cavity designs. J. D. Res. 33:757 Dec. 1954.

3. Lee, G. H. An introduction to experimental stress analysis. New York, Wiley and Sons, 1950.

walls, were studied to see which cavity form would provide for the best distribution of stress and would be adapted best to operative procedures for the deciduous teeth. The following cavity forms were studied:

1. A shallow occlusal step with flat pulpal wall and acute buccopulpal and linguopulpal line angles.
2. A deep occlusal step with flat pulpal wall and acute buccopulpal and linguopulpal line angles.
3. A shallow occlusal step with flat pulpal wall and a grooved step portion with acute buccopulpal and linguopulpal line angles.
4. A deep occlusal step with flat pulpal wall and a grooved step portion with acute buccopulpal and linguopulpal line angles.
5. A shallow occlusal step with flat pulpal wall and gently rounded buccopulpal and linguopulpal line angles.
6. A deep occlusal step with flat pulpal wall and gently rounded buccopulpal and linguopulpal line angles.
7. A shallow occlusal step with gently rounded pulpal wall with angles obtained when the pulpal wall meets the buccal and lingual walls.
8. A deep occlusal step with gently rounded pulpal wall with angles obtained when the pulpal wall meets the buccal and lingual walls.
9. A shallow occlusal step with gently rounded pulpal wall in an approximate elliptic shape with gently rounded buccopulpal and linguopulpal line angles.
10. A deep occlusal step with gently rounded pulpal wall in an approximate elliptic shape with gently rounded buccopulpal and linguopulpal line angles.

## MATERIALS AND METHODS

Photoelasticity is a technic widely used in engineering to determine the distribution of internal stresses in structural members and machine parts.[4] Photoelastic stress analysis consists of the examination of stressed, double refracting, plastic models in a field of polarized light. Under these circumstances the models display a series of dark lines called fringes such as are shown in Figures 1 through 10. The shear stress in the model is a constant along any fringe. The shear stress difference between two successive fringes is also a constant, and is a factor peculiar to the material of which the model is made and its thickness. Thus, if the stress at any point along fringe no. 1 is S, the stress at any point along fringe no. 2 is 2S, and the stress at any point along fringe no. 3 is 3S, and so forth. The photoelastic analysis pertinent to this research was done using the 12-inch diffused field polariscope and other equipment in the experimental stress analysis laboratory of the department of engineering mechanics at the University of Nebraska.

In order to assure that all models tested represented realistic cavity preparations, the cavities were carved first in three-dimensional plaster models of mandibular second deciduous molars. These models were ten times the size of natural teeth in all linear dimensions. Since a certain amount of standardization is necessary in order to make comparisons possible, it was decided to standardize on two occlusal depths, 1 mm. and 1.5 mm. These dimensions represent the depths in the actual tooth and were correspondingly increased by a factor of ten when carved in the plaster model. Likewise the gingival wall, which in the natural tooth is prepared to the width of a no. 558 bur, was prepared to ten times this width in the plaster model. Representative buccolingual cross sections were selected in each model and the shape of the cavity preparation at the selected cross section was transferred to a piece of paper by means of proportional dividers. The proportional dividers were set at 2:1 ratio

4. Frocht, M. M. Photoelasticity, ed. 3. New York, Wiley and Sons, 1949.

so that the final drawing of the cross section of the cavity preparation was 20 times the size of the cross section in the natural tooth. These drawings in turn were cemented to 0.2 inch thick sheets of clear Catalin, a phenol-formaldehyde plastic suitable for use in photoelastic stress analysis. The plastic was then bandsawed to within 1/32 inch of the outline and finished to exact shape by hand filing. The drawing was then stripped from the completed model.

In order to make a realistic study of the stresses produced in the buccolingual sections it was necessary to support the models in a manner similar to that in which the restoration is supported in the tooth. To simulate the exactness with which a silver amalgam restoration fits the cavity preparation it was necessary to cast a matrix around each photoelastic model. Since Catalin is very sensitive to heat, it was necessary to cast the matrix of a low melting point alloy. The edges of each model were insulated with two layers of paper masking tape and the model placed between two plates of aluminum. A low fusing metal (melting point 160° F.) was poured around the model in such a manner as to embrace it on all edges except the one representing the occlusal surface. The metal was melted in warm water so as to insure that it would not be overheated, and the aluminum plates conducted the heat away from the Catalin model rapidly, so that the metal solidified almost immediately after pouring. After trimming, the matrix and model combination were ready for the polariscope.

Each model was placed on the loading frame of the photoelastic polariscope and examined in a field of circular polarized light. After an initial examination which showed negligible initial stress due to the machining and casting operations and the dead weight of the loading frame, each specimen was loaded with 160 pounds applied to the occlusal surface and the resulting fringe pattern was photographed. These photographs appear in Figures 1 through 10.

## DISCUSSION OF RESULTS

In discussing the internal stress pattern photographs that are presented in this study, it is important to keep in mind the following:

1. There should be a conformity of fringe pattern with the boundary of the restoration. If the fringe pattern does not conform to the boundary of the restoration it indicates that some points are understressed whereas other points are overstressed. The ideal fringe will follow the boundary smoothly giving a good distribution of stress.

2. There should be a low fringe order.

The following is an analysis of the stress patterns of the cavity designs studied:

1. A shallow flat pulpal wall with acute buccopulpal and linguopulpal line angles (Fig. 1).

A. Conformity—poor.

B. Maximum fringe order — four plus at the buccopulpal and linguopulpal line angles.

2. A deep flat pulpal wall with acute buccopulpal and linguopulpal line angles (Fig. 2).

A. Conformity—better than shallow pulpal wall because of the extra depth giving a greater distribution.

B. Maximum fringe order — four plus at the buccopulpal and linguopulpal line angles.

3. A shallow flat pulpal wall with a grooved step portion with acute buccopulpal and linguopulpal angles. This groove gave two more re-entrant angles for stress concentration (Fig. 3).

A. Conformity—very poor; stress concentration is noted at the re-entrant corners as well as the linguopulpal and buccopulpal angles.

B. Maximum fringe order—six plus at buccopulpal and linguopulpal line angles, seven plus at the re-entrant angles.

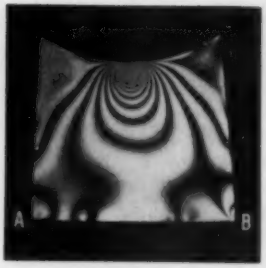



Fig. 1 • Distribution of stress is poor with stress concentration at acute buccopulpal (A) and linguopulpal (B) angles

Fig. 2 • Stress concentrated at acute buccopulpal (A) and linguopulpal (B) line angles; better stress distribution than in Figure 1

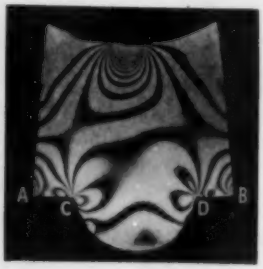



Fig. 3 • Very poor distribution of stress with high concentration at re-entrant angles (C-D) and buccopulpal (A) and linguopulpal (B) angles

Fig. 4 • Far left: Very poor stress distribution with high stress concentration at angles A, B, C, D

Fig. 5 • Distribution of stress is fair with less stress concentration at gently rounded buccopulpal (A) and linguopulpal (B) angles

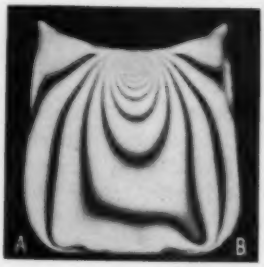



Fig. 6 • Distribution of stress is fair with a one plus fringe order at buccopulpal (A) and linguopulpal (B) rounded line angles

Fig. 7 • Good distribution of stress with a fringe order of one at buccopulpal (A) and linguopulpal (B) angles

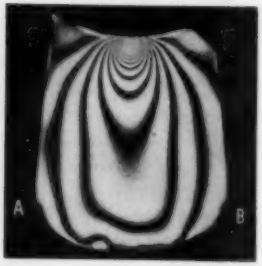
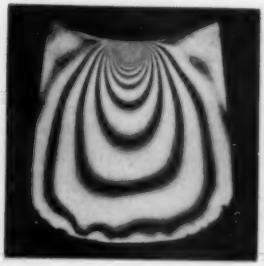



Fig. 8 • Good distribution of stress. There is a fringe order of one at the buccopulpal (A) and linguopulpal (B) line angles



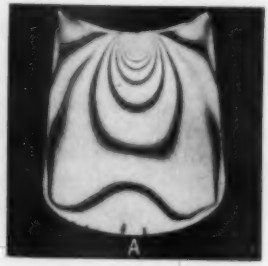



Fig. 9 • Far left: Distribution of stress is excellent with a one minus fringe order at the gently rounded line angles, and rounded pulpal wall

Fig. 10 • Distribution of stress is very good but not as uniform as seen in Figure 9. The fringe order is one minus along the pulpal wall and the gently rounded line angles. An isotropic point is seen in center at pulpal wall (A)

4. A deep flat pulpal wall with a grooved step portion with buccopulpal and linguopulpal angles. This groove gave two more re-entrant angles for stress concentration (Fig. 4).

A. Conformity—very poor; stress concentration is noted at the re-entrant corners as well as the linguopulpal and buccopulpal angles.

B. Maximum fringe order—four plus at buccopulpal and linguopulpal line angles, five plus at the re-entrant angles.

5. A shallow flat pulpal wall with gently rounded buccopulpal and linguopulpal line angles (Fig. 5).

A. Conformity—fair.

B. Maximum fringe order—two at buccopulpal and linguopulpal rounded line angles.

6. A deep flat pulpal wall with gently rounded buccopulpal and linguopulpal line angles (Fig. 6).

A. Conformity—fair.

B. Maximum fringe order — one plus at buccopulpal and linguopulpal rounded line angles.

7. A shallow rounded pulpal wall with angles obtained and when the pulpal wall meets the buccal and lingual walls (Fig. 7).

A. Conformity—good.

B. Maximum fringe order—one at buccopulpal and linguopulpal angles.

8. A deep rounded pulpal wall with angles obtained when the pulpal wall meets the buccal and lingual walls (Fig. 8).

A. Conformity—good.

B. Maximum fringe order—one at buccopulpal and linguopulpal line angles.

9. A shallow gently rounded pulpal wall with gently rounded buccopulpal and linguopulpal angles (Fig. 9).

A. Conformity—excellent; best of all types tested.

B. Maximum fringe order — one minus at buccopulpal and linguopulpal gently rounded line angles and pulpal floor.

10. A deep gently rounded pulpal wall with gently rounded buccopulpal and linguopulpal angles (Fig. 10).

A. Conformity — very good; not quite as uniform as the shallow shape.

B. Maximum fringe order — one minus at buccopulpal and linguopulpal gently rounded line angles and pulpal floor.

In cavity form no. 10, because of a greater amount of bulk at this depth, an isotropic point may be detected at the center of the pulpal wall indicating a point of low shear stress. It is believed that the radius of curvature of the pulpal wall is somewhat too short, relatively, to the filling depth. That is, the radius of curvature should be increased as the depth is increased for good conformity. This is an instance where extreme bulk is of no advantage, because the radius of the circle involved is not large enough to permit good conformity to the margins of the cavity form. Therefore, cavity form no. 9 is actually better than no. 10 because of the better conformity of the stress lines to the margins of the cavity preparation.

SUMMARY

1. Buccolingual sections of ten different Class II cavity forms were studied by means of photoelasticity to determine which cavity form would provide the best distribution of stress in the restoration.

2. The cavity preparation containing the gently rounded pulpal wall and gently rounded line angles showed the lowest maximum fringe order around the boundary of the model as well as the best conformity to the boundary.

3. A gently rounded pulpal wall and gently rounded line angles may be recommended as desirable features to include in the Class II cavity preparation.

4. The results obtained in this study are applicable also to Class I cavities prepared in the occlusal region of bicuspid and molar teeth.

*625 East Evans Street*

# Microscopic investigation of root canal diameters

*Edward N. Green, D.D.S., M.S., Miami, Fla.*

Today, greater emphasis is placed on conserving teeth by means of endodontic treatment than was previously, and the need for research in this field has also increased. One of the phases of study that has been neglected until recently is the accurate determination of root canal size and taper. The minuteness and irregularity of canals have caused most investigators to abandon any attempt at actually making measurements through a microscope, although the volumes of root canals have been determined by other methods.[1,2] Nevertheless, information on sizes and tapers can be of great value to the endodontist by aiding him in visualizing the dimensions of root canals before and during the procedures of preparing and filling them. The success of endodontic treatment, as with any other operation, depends to a large degree on the dentist's knowledge of the anatomy of the region involved. Furthermore, such data are needed for correlation with the sizes of files, reamers, silver cones, gutta percha cones, pluggers and broaches and may provide the manufacturer of these instruments and materials with a basis more precise than trial and error for the determination of the necessary diameters.

Scant mention of root canal sizes is made in the literature. In 1867 Latimer[3] observed the sizes of the foramens of mandibular molar roots, not the canals, which he said were impossible to classify on paper. In 1925, Barrett[4] reported a study of 512 sectioned permanent teeth and stated, without further elucidation, that "the canals vary greatly in size, ranging from about 20 to 35 microns to 250 microns for the larger examples."

In 1933, Mueller[5] tabulated root canal sizes under the heading, "Range in Millimeters of Canal Size in Gingival Third." The table provides figures for incisors, cuspids and bicuspids only, and there is no mention of the sizes of the canals in the middle third or apical third of the roots.

Meyer and Scheele[6] examined root canals by making serial cross sections of the roots, the canals of which were then reproduced in wax. According to their observations, histological preparations show that the major canal may be moderately narrow and its ramifications may

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This paper is part of a thesis, submitted in partial fulfillment of the requirements for the degree of Master of Science, Horace H. Rackham School of Graduate Studies, University of Michigan.

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be extremely fine, in the order of 0.025 to 0.5 mm. (25 to 500 microns).

Measurements of root canals were obtained by Kuttler[7] by examining 268 teeth from cadavers. At the dentinocemental junction, the average diameter of all canals was approximately 300 microns for teeth from persons less than 25 years of age and 270 microns for teeth from persons who were more than 55 years of age. The measurements of all teeth, anterior and posterior, were averaged together.

David Green[8] examined the root apexes of 100 mandibular molars through a stereomicroscope and reported that the average diameter of the major apical foramens of the mesial roots was 0.52 mm. (520 microns), whereas that of the distal roots was 0.64 mm. (640 microns). Considering the data of Grove,[9] Coolidge,[10] Davis[11] and others, there is strong evidence that the funneling of the apical foramen can be verified by measurement, since the figures given for the diameter of the foraminal opening at the surface of the cementum are usually up to double those given for the diameter ½ to 1 mm. inside the foramen.

## PROCEDURE

Preliminary screening of several procedures was carried out so that the best one could be selected. For example, sagittal sections were prepared and measured, but the greatest diameter of the canal was difficult to determine accurately when sagittal grinding had been carried out. Furthermore, the diameter of the canal could be measured in only one direction. An attempt to measure the cross sections of roots that had been prepared previously by dental students was unsuccessful because, under microscopic examination, the teeth, as well as canals which had been subjected to filing or otherwise disturbed, revealed cracks and imperfections. Moreover, no positive identification as to level of the cut could be made, since many cross-sectional cuts had been made close together. The effect which drying of the teeth had on canal size was determined by a pilot study in a small number of teeth. This study showed that the specimens could not be allowed to dry before examination if measurements were to be accurate.

After the decision to measure the cross-sectional diameters of the root canals of wet teeth was made, the number and levels of the cuts had to be determined. One cross section at 5 to 6 mm. from the apex was decided on immediately, as the dentist who is carrying out endodontic therapy is most interested in the apical third of the root canal. Prior to establishing the level of the second cross section, which was to be made closer to the apex, measurements of apical cementum were made. The cementum thickness was found generally to range from 200 to 1,000 microns and seldom to exceed 1 mm. These figures supported the findings of other investigators.[7, 12-14] In this regard, the discussions by Grove[9] and Coolidge[10] relative to the presence of an apical constriction were evaluated. Thorough consideration of the factors mentioned led to the selection of the method. A section was made ½ to 1 mm. from the apical foramen and 5 to 6 mm. from the foramen so as to expose the canal for measurements which would reveal the true canal size (Fig. 1).

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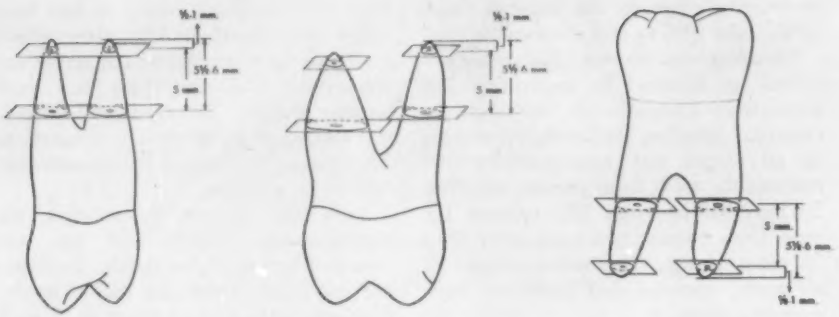

Fig. 1 • Drawings of maxillary first bicuspid (left), maxillary molar (center) and mandibular molar (right) showing levels at which cross sections were made to expose root canals for microscopic measurement

The root canals of 110 extracted human teeth were examined, giving a total of 260 roots, approximately 300 canals, and approximately 1200 cross-sectional measurements (two diameters at each of two levels), which were tabulated and analyzed. Included were 30 maxillary first bicuspids, 20 maxillary first molars, 20 maxillary second molars, 20 mandibular first molars and 20 mandibular second molars. These particular teeth were selected for study because of their extremely fine canals, which present difficult problems of endodontic instrumentation. The root apexes of the specimens revealed no evidence of resorption or fracture under magnification.

Individually labeled ½ ounce bottles partly filled with 10 per cent Formalin were utilized to keep the teeth wet and separated. Teeth of the same type were kept in a group by means of a coding system of colored dots, and each tooth was given a number.

A specimen was removed from the bottle, and Masson trichrome stain, which contains fast green, was placed on the root apex to reveal the foramen or foramens more clearly. With a saw-edged disk, measuring approximately 120 microns in thickness and mounted in a mandrel in a straight handpiece, a cut was made ½ to 1 mm. from the apical foramen and as nearly as possible at right angles to the long axis of the main canal. In the usual instance in which the foramen opened at or close to the root apex, the cut was made at right angles to the long axis of the root. In those instances in which the foramen did not open directly on the apex, the section was made at a slight angle, in an attempt to cut perpendicular to the canal. Even when more than one foramen was evident on the root surface, usually only one canal appeared at the level of section. This shows that these additional foramens were often the ends of short accessory canals which join the main canal 1 mm. or less from the root tip and were consequently cut away. When a canal in addition to the major canal appeared at the level of section, a notation was made in the tables.

After the root tips of a tooth were sectioned, the tooth was replaced in its bottle. No attempt was made to remove the pulp tissue from the canals at any time, nor was the canal itself disturbed.

For measurement of the canal diameter at the ½ to 1 mm. level, a tooth was removed from its bottle, dried with tissue paper, and mounted on a microscope slide with the roots up, the crown being fastened to the slide with soft utility wax (Fig. 2). The crowns were left intact

Fig. 2 • Maxillary molar, with roots sectioned 5 to 6 mm. from apical foramens, mounted upright with soft wax on glass slide prior to examination

throughout the investigation to facilitate handling and mounting and to serve as a reference for orientation under the microscope.

All bicuspids were mounted with the buccal root on the right and all molars so that the mesiobuccal canal appeared in the upper right-hand corner. This arrangement, which was arbitrary but systematic, was important in the correlation of the measurements at the two levels and later proved helpful during photomicrography of the canal cross sections.

The cut surface was stained, and the specimen was laid aside while a second tooth root was stained, thereby allowing the dye on the first tooth to penetrate sufficiently to outline the canal clearly.

The first tooth specimen was placed on the platform of the micrometer-measuring microscope, which provides a 32 diameter magnification (Fig. 3). The microscope was focused on the cut surface (Fig. 4), and the hairline in the eyepiece was lined up tangential to the circumference of the canal and at right angles to a line across the widest or the narrowest apparent diameter of the canal. The microscope is designed so that revolution of the adjustment knob moves the whole optical unit in which the measuring mechanism is incorporated mechanically, until the hairline arrives tangential to the opposite side of the canal circumference, with the tooth remaining stationary. Subtraction of the readings taken from the scales before and after rotation of the optical unit gave the diameter of the canal in microns.

The mounted tooth was then rotated, usually about 90 degrees, and a second measurement of the canal diameter made (Fig. 5). These two numbers were recorded as "N" and "W," the narrowest and widest diameters of the canal. The accuracy of this method is $\pm$ 1 per cent.

After completion of the measurements at the ½ to 1 mm. level, the roots were sectioned 5 to 6 mm. from the apex. They were placed on a millimeter ruler and were sectioned with a disk as described previously perpendicularly to the long

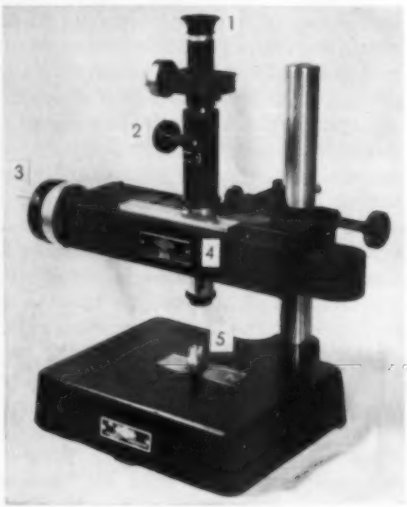


Fig. 3 • Micrometer-measuring microscope. 1. Eyepiece containing hairline. 2. Focusing knob. 3. Adjustment knob for moving optical unit laterally during measurement. 4. Housing containing measuring mechanism. 5. Tooth in position on platform

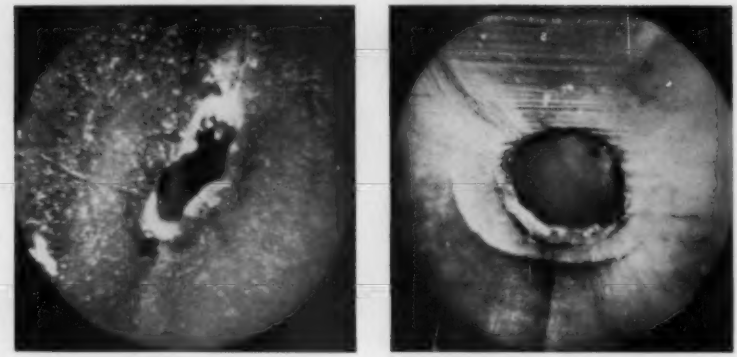

Fig. 4 • Cross sections of two canals as seen through microscope. Section on left was made ½ to 1 mm. from apical foramen and that on right was made 5 to 6 mm. from foramen

axis of the root with allowance being made for the length of the root tip that had already been removed. The cut surfaces were stained and measured, and the data were tabulated.

Measurements of irregularly shaped canals were somewhat more difficult to obtain than those of canals with round or oval shapes. In the mesial roots of mandibular molars, the canal as revealed by the cross section was often the shape of a dumbbell or hourglass, and three or four measurements could be determined—the widest portion, the narrowest portion (isthmus), and the diameter of the two ends of the ribbon, which represent continuations of the mesiobuccal and mesiolingual canals. At least two measurements, representing the narrowest and widest portions of the canal, were obtained for each cross section.

## RESULTS

Microscope readings were in microns, one thousandth of a millimeter. Approximately 25.4 millimeters equal one inch. To aid the reader in visualizing the root canal sizes by comparing them with a known factor, Kerr root canal files were measured. One millimeter from the tip, three no. 1 files averaged 120 microns; three no. 3 files, 230 microns; and three no. 5 files, 420 microns. Measurements taken at 6 mm. from the tips of three no. 1 files averaged 200 microns; three no. 3 files, 310 microns; and three no. 5 files, 570 microns.

The diameters of the root canals of individual teeth were tabulated, and the mean diameters were calculated by adding the individual measurements together and by dividing by the number of canals. These data were tabulated and graphs were made to facilitate easy comparison of one canal with another and of the canals of one tooth with those of another (Fig. 6 and 7).

In both graphs the narrow mean diameter in microns is indicated by the first bar of the three bars. The middle bar represents the average of the narrow and wide diameters, and the last bar represents the wide mean diameter of the canal. The diameters of the canals of the maxillary first bicuspid are given in Fig. 6. Also given in Fig. 6 are the diameters of the smaller canals of the molars. The diameters of the larger canal in the lingual root of maxillary molars and in the distal root of mandibular molars are given in Fig. 7.

*Maxillary First Bicuspids* • Only bicuspids with two distinct roots were selected for this study. All 30 teeth had canals that were evident at both 1 and 6 mm. levels in both roots. Some canals were nearly round, whereas others had distinctly oval shapes. Comparison of the mean diameters shows that the narrow mean diameter was less for the buccal canal at each level, whereas the wide mean diameter was greater for the buccal canal at each level. Therefore, on the average, the lingual canals were more nearly round than the buccal canals, although their average diameters (middle bars on the graph in Fig. 6) were approximately equal.

*Maxillary Molars* • The maxillary first molars had mesiobuccal canals which were fairly consistent in shape near the apex but slightly variable at the 6 mm. level, where the shapes revealed by the cross sections definitely were compressed and ribbon shaped. This observation makes apparent the reason for difficulties in negotiating and cleansing this canal and also shows that a better seal can be expected by filling the canal to the apical foramen. The distobuccal canals were slightly larger at both levels than the mesiobuccal canals but had similar shapes (Fig. 6). The lingual root canals were, of course, considerably larger as well as somewhat rounder and fairly evenly tapered (Fig. 7).

The size of the root canals of the maxillary second molars showed a tendency opposite to that of root canals of the first molars, the distobuccal canals appearing smaller at both levels than the mesiobuccal canals. Nearer the apex, the canals tended to be less oval, whereas, at the 6 mm. level, the outlines often appeared more oval.

*Comparisons* • Comparison of the canals of maxillary first and second molars shows that the mesiobuccal canals of each had similar mean narrow and wide

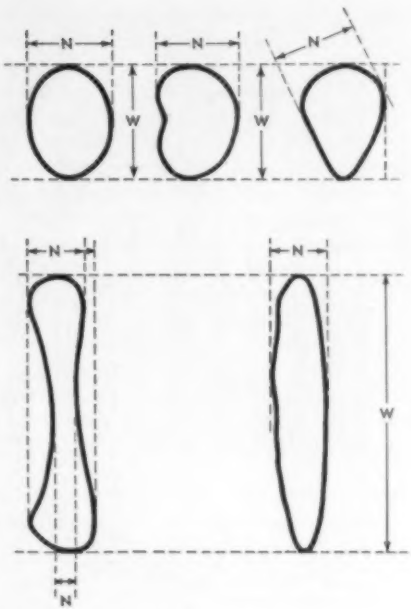


Fig. 5 • Root canal outlines showing how narrow ("N") and wide ("W") diameters of canal cross sections were measured

diameters at the apex. At the 6 mm. level, however, the narrow mean diameter of the mesiobuccal canals of the second molar was slightly greater, and the wide mean diameter was much greater. On the average, the distobuccal canal of the first molar was larger than that of the second molar near the apex and also 6 mm. from the apex. Furthermore, comparison of the canal tapers shows that more binding of a file in the distobuccal canal of the maxillary second molars could be expected than in the other canals. The lingual canals of the maxillary second molars were very much larger than those of the first molars, except that, at ½ to 1 mm. from the apex, the wide mean diameters were approximately equal. In this study, the two buccal canals of maxillary second molars were smaller than those of the first

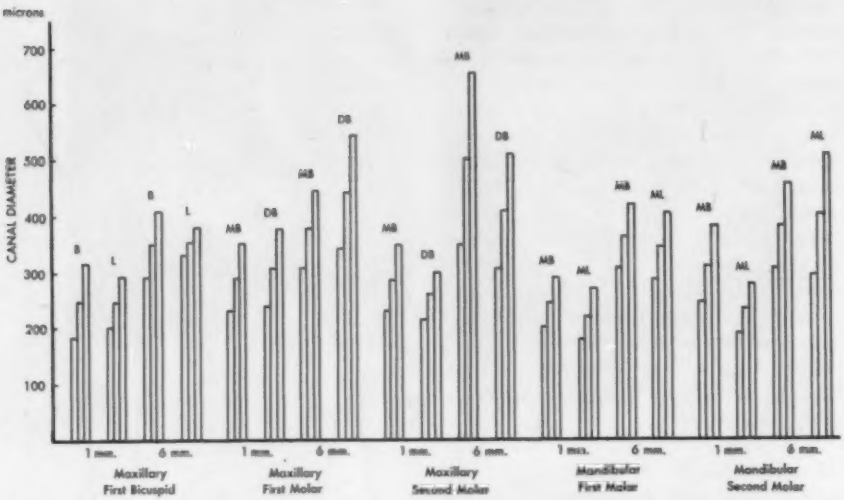


Fig. 6 • Graph showing mean diameters in microns of root canals in maxillary bicuspid and of smaller canals in molars. First of three bars represents narrow mean diameter of canals, and third bar represents wide mean diameter. Middle bar gives average of narrow and wide mean diameters. The letter "B" refers to buccal, "L" to lingual, "MB" to mesiobuccal, "DB" to distobuccal and "ML" to mesiolingual

molars, although the lingual canals tended to be larger.

*Mandibular Molars* • Nineteen of the 20 mandibular first molars had two canals in the mesial root. Five of the 20 teeth also had two distinct canals in the distal root. The mesiobuccal canals were fairly round at both levels, although, at the 6 mm. level, the canals were joined in some instances with the mesiolingual canal by a very fine corridor, measuring 20 or 30 microns. The mesiolingual canals, on the average, were also fairly round, and they were the finest of all the canals measured. Some distal roots had two canals, and, in these instances, the distobuccal canal was usually the smaller of the two, indicating that the main canal of the distal root should be sought in a somewhat lingual position. It is of practical value to note that when a distal canal is found to be small, another canal should be sought in that root, and, if such a canal is present, it is likely to be buccal to the one previously discovered. Distolingual canals, in such instances, were rather small at the 6 mm. level, whereas single distal canals usually appeared large and frequently appeared ribbon shaped. Although they were rounded near the apex, the distal canals showed distinct oval or elongated diameters at the 6 mm. level, indicating an angular taper.

The mesiobuccal canals of the mandibular second molars were usually larger than the mesiolingual canals. In 4 of the 20 teeth, only one canal could be found in the mesial root at the ½ to 1 mm. level; 8 of the 20 teeth had distinctly ribbon-shaped canals, indicating joining of the mesiobuccal and mesiolingual canals by a corridor of variable width. Only 6 of the 20 teeth revealed distinct mesiobuccal and mesiolingual canals at both levels. When only one mesial canal was present, it was usually nearly as large as the distal canal. The mandibular second molars were the only group in which there was

an exception to the otherwise consistent ratios of narrow and wide mean diameters, with the wide mean diameter of the mesiolingual canals being less than the wide mean diameter of the mesiobuccal canals near the apex but greater at the 6 mm. level. Such a deviation can be explained by the fact that measurements of larger single canals, which were found occasionally in mesial roots of mandibular second molars, were included in calculating the mean diameters of the mesiobuccal canals because they were usually found in that position. The number of figures available for calculating the mean wide diameter of the mesiolingual canals at the 6 mm. level was thereby considerably reduced. The distal roots had only one canal, which was considerably larger than the canals of the mesial roots. Although canals in the distal roots were quite round at the apex, they were somewhat flattened at the 6 mm. level, with the wide diameter being more than 1 mm. in 8 of the 20 teeth. This fact emphasizes the necessity for obtaining a tight seal in the apical region, and the desirability of lateral condensation to obliterate the wider portion of the canal.

*Comparisons* • Comparison of mandibular first and second molars shows that the second molars had mesiobuccal canals somewhat larger on the average than those of the first molars at the ½ to 1 mm. level, but this disparity was found to be less at the 6 mm. level. Mesiolingual canals at the apical section of the second molars were almost identical in dimension with those of the first molars, but at the 6 mm. level they were larger and less regular in shape.

## CONCLUSIONS

With all of the data being considered, it is evident that the small canals of molars and maxillary bicuspids did not differ greatly in size near the apical foramen from one tooth to another, nor did the larger canals of the molars vary greatly, with certain exceptions. The slight variations that did exist, however, would be important to the practitioner of endodontics, and the following conclusions can be made:

1. Both the narrow and wide diameters of root canals should be considered when discussing canal debridement, because the file or reamer cuts dentin in a straight canal when the instrument is as large as the narrow diameter of the canal, whereas all organic matter and debris are not removed until its wide diameter is reached by the instrument. Since complete debridement is the objective of instrumentation and irrigation, a knowledge of canal diameters can aid in judging

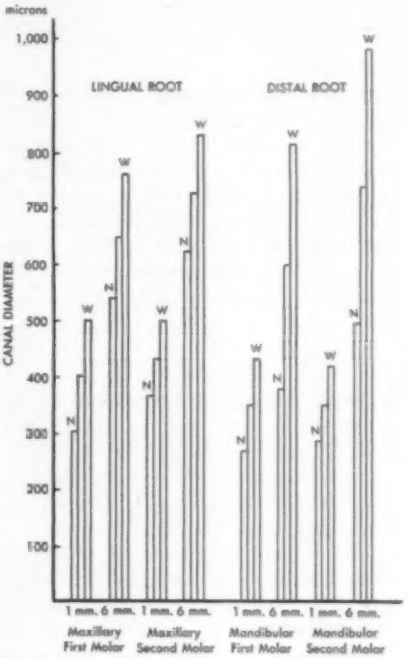


Fig. 7 • Graph of mean diameters in microns of large canals in lingual roots of maxillary molars and distal roots of mandibular molars. "N" bars represent narrow mean diameters, "W" bars represent wide mean diameters and middle bars represent average of these two measurements

the amount of filing and reaming necessary to cleanse the canal, although fine canals are usually curved and often have constrictions and although certain physical limitations are imposed by the construction of the instruments.

2. The majority of the fine canals would have been adequately debrided by a no. 3 file, but a very few would have been sufficiently cleansed by a file smaller than no. 3. In several instances, filing with a no. 4 file, though rarely with a larger file, would have been necessary to completely debride the small canals.

3. The majority of the large molar canals would have been debrided adequately by a no. 5 file, but in a very few instances a smaller instrument would have been adequate. Some of the large molar canals would have required filing with a no. 6 or larger file for thorough debridement.

4. It should be kept in mind that individual teeth present specific variations of canal anatomy depending on natural characteristics and secondary dentin formation, which is related to age, caries, occlusion, trauma and other factors which the clinician must evaluate to the best of his ability preparatory to and during endodontic treatment.


## SUMMARY

An investigation was undertaken to determine the cross-sectional diameters, wide and narrow, of the root canals of extracted human molar and maxillary bicuspid teeth. These teeth were chosen for study because of their extremely fine canals, which offer problems in endodontic treatment. The 110 specimens were kept separated in ½ ounce bottles, partly filled with 10 per cent Formalin and individually labeled. The roots were sectioned at right angles to the root canal at two levels: ½ to 1 mm. and 5 to 6 mm. from the apical foramen. Prior to examination, each tooth was mounted on a glass slide, and Masson trichrome stain which contains fast green was used to delineate the canal more clearly. Measurements were made with a micrometer-measuring microscope at 32 diameters magnification.

Approximately 1200 measurements of 300 root canals were tabulated and mean diameters were calculated. Graphs were prepared to facilitate study and comparison. The observations were as follows:

1. The buccal and palatal canals of maxillary first bicuspids were similar in size close to the apical foramen as well as 5 to 6 mm. from it.

2. The distobuccal canals of maxillary first molars were found to be slightly larger than the mesiobuccal canals, particularly when measurements were made 6 mm. from the root apex. The maxillary second molars exhibited the opposite tendency—the mesiobuccal canals being larger than the distobuccal canals.

3. The mesiobuccal canals of mandibular first molars were slightly larger than the mesiolingual canals. This was found to an even greater degree in the mesial canals of mandibular second molars near the apex, but at the 6 mm. level the wide dimension of the mesiolingual canals was slightly larger than the mesiobuccal canals and the narrow dimension was slightly smaller.

4. The lingual root canals of maxillary first molars were somewhat smaller than those of maxillary second molars.

5. The distal root canals of mandibular first molars and second molars were similar in size close to the apex, but at the 6 mm. level the distal root canals of the mandibular first molars were smaller than those of the second molars.


*P.O. Box 4339*

# Cutting characteristics of an ultrasonic dental unit and various types of rotary burs

*George W. Burnett, D.D.S., Ph.D.; George M. Yamane, D.D.S., M.S., and Thomas A. McFall, D.D.S., Washington, D. C.*

In 1934[1] and again in 1947[2] it was suggested that instruments generating ultrasonic vibrations might be useful in dentistry. Within recent years adaptations have been made of high frequency vibrating instruments powered by variable frequency oscillators for the clinical practice of dentistry, particularly for operative dentistry and to a lesser degree for endodontics and periodontics.[3-8]

Although a number of investigations have been made of the possible effect on soft tissues of ultrasonic vibrations emanating from the dental instruments and of the technic of using such high frequency vibrating instruments in dentistry,[9-22] only a few objective studies have been reported of the cutting characteristics of the ultrasonic dental instrument or the comparison of such characteristics with those of rotary cutting tools.[7, 23] Consequently, an investigation was undertaken of the cutting rates of an ultrasonic dental unit (Cavitron), apart from any possible biological effect on soft tissue, both when manipulated by an operator and when subjected to constant pressures for cutting enamel, dentin, combinations of enamel and dentin, or amalgam. Comparisons have been made with the cutting rates of selected steel and carbide burs rotating at different speeds in similar substances.

## TECHNICAL PROCEDURES

For studying the cutting characteristics of the ultrasonic dental unit under practical conditions, an operator, who performed all subsequent testing, became thoroughly proficient with the use of the instrument before determining its cutting efficiency or before making tests comparing the cutting efficiency of the unit with the cutting efficiency of steel or carbide burs. The cutting tool of the ultrasonic

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dental unit vibrated at 29,000 times per second over a distance of 0.0014 inch (35.5 microns), utilizing a 20 per cent water solution of aluminum oxide ($Al_2O_3$) as an abrasive.

The burs tested were composed of either steel or tungsten carbide. In the various tests, burs were rotated at maximum speeds of either 4,000 rpm or 13,000 rpm under a cooling spray of water. The rotating speeds of the burs were checked with a stroboscope and maintained at the given speed during the test period except as indicated. Cutting time, according to the conditions of the particular experiments, was three minutes continuously, five minutes intermittently at one minute intervals, or six minutes continuously. For cutting, extracted teeth were utilized and the operator attempted to cut as much as possible of enamel, dentin, or a combination of enamel and dentin during the test period.

Similarly, cutting rates in amalgam were determined on fillings in extracted teeth. Cutting efficiency was based on the amount of tissue or amalgam removed during the cutting period. An apparatus was prepared as shown in Figure 1 for applying constant pressures and standardized conditions when determining cutting rates of the ultrasonic dental unit and rotating burs. This instrument allowed the placement of any desired load on the cutting tip of the instrument or bur for any given time.

*Cutting Rates of an Ultrasonic Dental Unit and Rotary Burs When Manipulated by an Operator* • The cutting rates of the ultrasonic instrument and rotary burs when manipulated by an operator in human enamel and dentin were determined during a three minute period and the results are summarized as the mean

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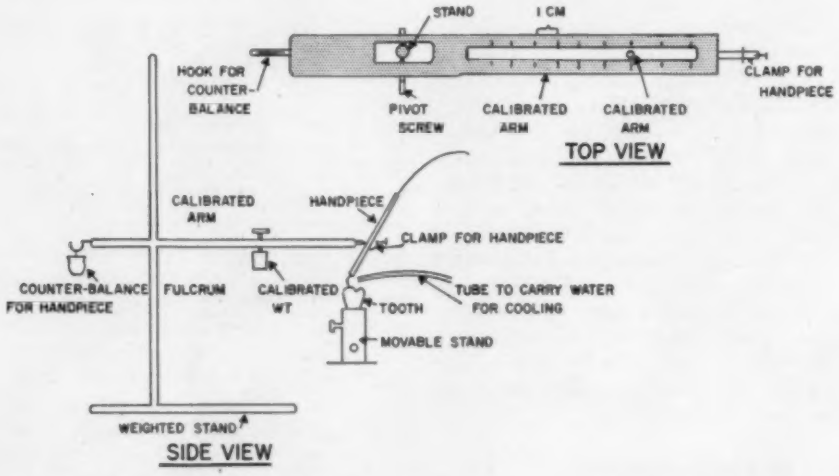


Fig. 1 • Device for applying a constant and predetermined pressure to the cutting tip of an ultrasonic dental unit or to burs in a handpiece when determining cutting efficiency

and range of the amount of tissue removed in Figure 2 and Table 1. The data have been subjected to statistical analysis in Table 1. Critical ratios (difference between the means divided by its standard error) were calculated for comparison of significance between all possible combinations of cutting conditions. If such critical ratios were two or more the differences were considered significant; if less than two they were considered not significant.

In cutting enamel with the ultrasonic dental unit, the operator made 24 cuts, each of three minute duration, using 23 different types of tips. In determining the cutting rate of burs, ten cuts, each of three minutes duration, were made in enamel with nos. 559 and 37 steel and carbide burs, utilizing a new bur for each cut. On an average, the ultrasonic unit removed much more enamel than any of the burs except for nos. 559 and 37 carbide burs rotating at 13,000 rpm. The steel burs cut much less enamel than did the carbide burs. The no. 559 carbide burs rotating at 13,000 rpm cut significantly more enamel than the ultrasonic unit. Except in one instance, when conditions were similar, no. 559 steel burs removed significantly more enamel than no. 37 steel burs. During the three minute cutting period, no. 559 steel burs cut more enamel when rotating at 4,000 rpm than they did when rotating at 13,000 rpm. On the other hand, no. 37 steel burs removed more enamel when revolving at 13,000 rpm than when revolving at 4,000 rpm. Carbide burs were not tested for their cutting efficiency when rotating at 4,000 rpm but both nos. 559 and 37 carbide burs rotating at 13,000 rpm were, on an average, considerably more efficient for removing enamel than either the ultrasonic unit or steel burs. The cutting efficiency of nos. 559 and 37 carbide burs did not differ significantly when rotating at 13,000 rpm.

An investigation was made of the weight loss of the cutting tools of the

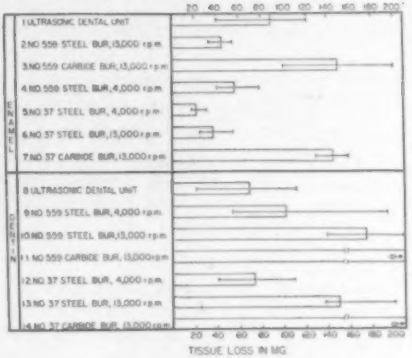
20 40 60 80 100 120 140 160 180 200
1 ULTRASONIC DENTAL UNIT
2 NO 559 STEEL BUR, 13,000 r.p.m.
3 NO 559 CARBIDE BUR, 13,000 r.p.m.
4 NO 559 STEEL BUR, 4,000 r.p.m.
5 NO 37 STEEL BUR, 4,000 r.p.m.
6 NO 37 STEEL BUR, 13,000 r.p.m.
7 NO 37 CARBIDE BUR, 13,000 r.p.m.
ENAMEL
8 ULTRASONIC DENTAL UNIT
9 NO 559 STEEL BUR, 4,000 r.p.m.
10 NO 559 STEEL BUR, 13,000 r.p.m.
11 NO 559 CARBIDE BUR, 13,000 r.p.m.
12 NO 37 STEEL BUR, 4,000 r.p.m.
13 NO 37 STEEL BUR, 13,000 r.p.m.
14 NO 37 CARBIDE BUR, 13,000 r.p.m.
DENTIN
20 40 60 80 100 120 140 160 180 200
TISSUE LOSS IN MG.

Fig. 2 • Mean and range of the quantity of enamel or dentin an operator was able to remove with the ultrasonic dental unit or burs during a three minute cutting period. Bar graph 1 represents mean amount of enamel removed by 23 different ultrasonic tips to give a total of 24 cuts (tips used were nos. 1-5, 10-14, 20-23, 30-32, 40-42, 50, 51, and 61) and bar graph 7 represents amount of dentin removed by 20 different ultrasonic tips which were used for a total of 20 cuts (tips used were nos. 1-5, 10-14, 30-33, 40-42, 50, 51, and 61). For the burs, each bar graph represents mean of enamel or dentin removed in milligrams during ten cuts, each of which was made separately with a new bur for the three minute cutting period. When nos. 37 and 559 carbide burs were used at 13,000 rpm to cut dentin, tissue was cut so rapidly that it was impossible to control the burs adequately during the three minute period, hence they are indicated as cutting an infinite amount

ultrasonic unit and burs when cutting enamel. The cutting tools of the ultrasonic unit (Cavi-tips) were weighed before and after making the three minute cut. Their average weight before cutting was 1.0761 Gm., with a range extending from 0.8480 to 1.4085 Gm. Since different types were used, the range in weight of the tips was considerable. The average amount of the tip lost during the three

20. Grinnel, H. Evaluation and analysis of high speed technics. New York J. Den. 25:25 Jan. 1955.

21. Lefkowitz, W. Ultrasonics in dentistry. J.A.D.A. 52:406 April 1956.

22 Wilhelmy, G. E. Critical evaluation of ultrasonics in operative dentistry. D. Digest 63:106 March 1957.

23. Hartley, J. L. Cavity preparation by ultrasonic versus rotary instrumentation. U. S. Armed Forces M. J. 8:519 April 1957.

**Table 1** • Statistical analysis of the cutting efficiency of an ultrasonic unit and rotary burs when manipulated by an operator

| Type of instrument | Speed of rotation (rpm) | Number of cuts | Type of tissue | Mean amount of tissue removed (mg.) | Range of amount of tissue removed (mg.) | Standard deviation | Standard error of mean | Coefficient of variation % |
|---|---|---|---|---|---|---|---|---|
| 1. Ultrasonic dental unit | | 24 | Enamel | 88.9 | 40.3–122.9 | 26.25 | 5.36 | 29.53 |
| 2. No. 559 steel bur | 13,000 | 10 | Enamel | 45.5 | 33.4– 55.6 | 7.96 | 2.52 | 17.49 |
| 3. No. 559 carbide bur | 13,000 | 10 | Enamel | 150.6 | 100.4–200.1 | 24.95 | 7.89 | 16.57 |
| 4. No. 559 steel bur | 4,000 | 10 | Enamel | 56.7 | 42.6– 78.6 | 11.07 | 3.50 | 19.52 |
| 5. No. 37 steel bur | 4,000 | 10 | Enamel | 21.1 | 15.8– 32.0 | 4.72 | 1.49 | 22.37 |
| 6. No. 37 steel bur | 13,000 | 10 | Enamel | 37.3 | 25.4– 54.7 | 13.02 | 4.12 | 34.91 |
| 7. No. 37 carbide bur | 13,000 | 10 | Enamel | 146.2 | 130.3–159.0 | 8.67 | 2.89 | 5.93 |
| 8. Ultrasonic dental unit | | 20 | Dentin | 69.7 | 25.4–113.8 | 25.90 | 5.79 | 37.16 |
| 9. No. 559 steel bur | 4,000 | 10 | Dentin | 102.7 | 54.5–194.8 | 38.89 | 12.29 | 37.86 |
| 10. No. 559 steel bur | 13,000 | 10 | Dentin | 175.0 | 140.9–206.3 | 27.48 | 8.69 | 15.70 |
| 11. No. 559 carbide bur | 13,000 | | Dentin | * | | | | |
| 12. No. 37 steel bur | 4,000 | 10 | Dentin | 73.6 | 41.8–112.9 | 20.43 | 6.46 | 27.76 |
| 13. No. 37 steel bur | 13,000 | 10 | Dentin | 151.6 | 137.5–202.1 | 19.49 | 6.16 | 12.85 |
| 14. No. 37 carbide bur | 13,000 | | Dentin | * | | | | |

*Not measurable under conditions of the experiment.

Critical ratios for comparison of the various types of cutting instruments

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 vs 2= 7.32 | 2 vs 3=12.66 | 3 vs 5=16.13 | 4 vs 8= 1.92 | 5 vs 13=20.58 | 7 vs 13= 0.79 | |
| 1 vs 3= 6.19 | 2 vs 4= 2.59 | 3 vs 6=12.73 | 4 vs 9= 3.59 | 6 vs 7=21.65 | 8 vs 9= 2.43 | |
| 1 vs 4= 5.03 | 2 vs 5= 8.33 | 3 vs 7= 0.52 | 4 vs 10=12.61 | 6 vs 8= 4.56 | 8 vs 10=10.08 | |
| 1 vs 5=12.19 | 2 vs 6= 1.70 | 3 vs 8= 8.26 | 4 vs 12= 2.30 | 6 vs 9= 5.03 | 8 vs 12= 0.45 | |
| 1 vs 6= 7.63 | 2 vs 7=26.29 | 3 vs 9= 3.28 | 4 vs 13=13.38 | 6 vs 10=14.31 | 8 vs 13= 9.64 | |
| 1 vs 7= 9.55 | 2 vs 8= 3.93 | 3 vs 10= 2.08 | 5 vs 6= 3.70 | 6 vs 12= 4.73 | 9 vs 10= 4.82 | |
| 1 vs 8= 2.43 | 2 vs 9= 4.55 | 3 vs 12= 7.55 | 5 vs 7=38.49 | 6 vs 13=15.40 | 9 vs 12= 2.19 | |
| 1 vs 9= 1.03 | 2 vs 10=14.31 | 3 vs 13= 0.10 | 5 vs 8= 8.13 | 7 vs 8=11.81 | 9 vs 13= 3.54 | |
| 1 vs 10= 8.44 | 2 vs 12= 4.05 | 4 vs 5= 9.34 | 5 vs 9= 6.58 | 7 vs 9= 3.44 | 10 vs 12= 9.35 | |
| 1 vs 12= 1.82 | 2 vs 13=15.93 | 4 vs 6= 3.59 | 5 vs 10=16.32 | 7 vs 10= 3.14 | 10 vs 13= 2.20 | |
| 1 vs 13= 7.67 | 3 vs 4=10.87 | 4 vs 7=19.71 | 5 vs 12= 5.48 | 7 vs 12=10.21 | 12 vs 13= 8.72 | |

Critical ratios of two or more are considered significant; if less than two they are considered not significant.

minute cutting period was 8 mg., with a range extending from 3.5 to 15.3 mg. Since the average amount of enamel removed during the three minute period was 88.9 mg., the ratio of enamel loss to cutting tool loss was 11 to 1.

For comparison, the weight loss of steel burs when cutting enamel was also determined for the three minute period. The ten no. 559 burs used to cut enamel at 4,000 rpm weighed an average of 1.1898 Gm., ranging in weight from 1.1795 to 1.1963 Gm. The average weight loss of these burs during the three minute cutting period was 0.59 mg., with a range extending from 0.4 to 0.7 mg. Since the average amount of enamel removed during the three minute cutting period was 56.7 mg., the ratio of enamel loss to bur loss was 96 to 1. The average weight of the ten no. 37 steel burs used to cut enamel at 4,000 rpm was 1.1894 Gm., with the range extending from 1.1795 to 1.1934 Gm. The average weight loss of this type of bur was 0.36 mg., with the range extending from 0.2 to 0.5 mg. Since the average amount of enamel removed during the three minute period with this type of bur was 21.1 mg., the ratio of enamel loss to bur loss was 58 to 1.

In cutting dentin (Fig. 2), the ultrasonic unit, on an average, removed less tissue than did either the steel or carbide burs. Although the ultrasonic unit removed almost as much dentin as did the no. 37 steel bur revolving at 4,000 rpm, the amounts removed were not considered significantly different. The carbide burs rotating at 13,000 rpm removed so much dentin during the three minute cutting period that it was difficult when utilizing a single tooth to control cutting, hence the values are expressed as an infinite amount. When testing steel burs under similar conditions, no. 559 burs removed more dentin on an average than no. 37. Steel burs were more efficient, type for type, when cutting dentin at 13,000 rpm than when cutting such tissue at 4,000 rpm. The carbide burs were not tested for cutting dentin at 4,000 rpm.

A comparison was made of the weight loss of the cutting tools of the ultrasonic dental unit and rotary burs when cutting dentin. The average weight of the cutting tools of the ultrasonic unit was 1.0902 Gm., with the range extending from 0.8523 to 1.4903 Gm. The average amount of the tip lost during the cutting period was 4.3 mg., with the range extending from 2.0 to 8.5 mg. Since the average amount of dentin lost during the 3 minute cutting period was 69.7 mg., the ratio of dentin loss to cutting tool loss was 16 to 1.

For comparison, the weight loss of the steel burs used in cutting dentin was also determined for the three minute period. The ten no. 559 burs used to cut dentin at 4,000 rpm weighed an average of 1.1875 Gm., ranging in weight from 1.1674 to 1.1965 Gm. The average weight loss of these burs during the three minute cutting period was 0.02 mg., with a range extending from 0.00 to 0.06 mg. Since the average amount of dentin removed during the three minute cutting period was 102.7 mg., the ratio of tissue loss to bur loss was 5,135 to 1. The average weight of the ten no. 37 burs used to cut dentin at 4,000 rpm was 1.2320 Gm., with the range extending from 1.1888 to 1.2487 Gm. The average weight loss of this type of bur was 0.005 mg., with the range extending from 0.00 to 0.02 mg. Since the average amount of dentin removed during the three minute cutting period with this type of bur was 73.6 mg., the ratio of dentin loss to bur loss was 14,720 to 1.

*Cutting Rates of an Ultrasonic Dental Unit and Rotary Burs Under a Constant Load* • The cutting rates of the ultrasonic unit and rotary burs in human enamel and dentin were determined for a three minute period under constant loads. The data are presented graphically in

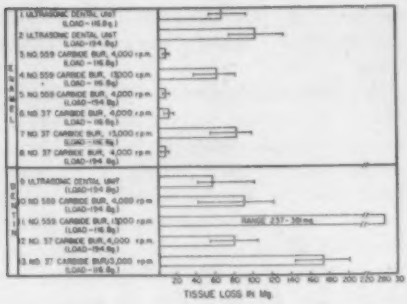


Fig. 3 • Mean and range of the quantity of enamel or dentin removed during a three minute cutting period under a constant load. Bar graph 1 represents mean amount of enamel removed by each of ten different ultrasonic tips operated at a constant load of 116.8 Gm. (tips used: nos. 1-4, 10-12, 31, 33, 50) and bar graph 2 represents the mean of amount of enamel removed in milligrams by each of ten different ultrasonic tips operated at a constant load of 194.8 Gm. (tips used: nos. 1, 3, 4, 10-12, 14, 30, 33, 41); bar graph 9 represents amount of dentin removed by each of 15 different ultrasonic tips operated at a constant load of 194.8 Gm. (tips used: nos. 1-5, 10, 12-14, 30, 32, 33, 40-42). For steel and carbide burs, each bar graph represents mean of enamel or dentin removed in milligrams during ten cuts, each of which was made separately with a new bur for the three minute cutting period at load indicated

Figure 3 as the mean and range of the amount of tissue removed for comparison with the data obtained when an operator manipulated the instruments (Fig. 2 and Table 1.) In Table 2, the data have been analyzed statistically. In cutting enamel with the ultrasonic unit, ten cuts were made with ten different tips each under a load of 116.8 Gm. (4.17 oz.) or 194.8 Gm. (6.95 oz.). Nos. 559 and 37 carbide burs were tested with loads of 116.8 Gm. or 194.8 Gm. and at speeds of 4,000 rpm or at 13,000 rpm. For each determination ten cuts were made utilizing a new bur for each cut.

Significantly more enamel was removed by the ultrasonic unit under a constant load of 194.8 Gm. than under a load of 116.8 Gm. Under a constant load of 116.8 Gm. less enamel was removed by the ultrasonic dental unit than when the instrument was manipulated by the operator. However, more enamel was removed under a constant load of 194.8 Gm. than when the instrument was manipulated by the operator. Under the loads employed, the cutting capacity of the ultrasonic dental unit in enamel compared favorably with that of the carbide burs rotating at 13,000 rpm. Only carbide burs were tested under a constant load on enamel. In general, the cutting capacity of the nos. 559 and 37 carbide burs, under a constant load and similar conditions, was greater in the hands of the operator than when the constant loads were employed. (See Figure 2 and Table 1 for comparison.) Furthermore, as might be expected, the carbide burs did not perform as efficiently at the lower speed of 4,000 rpm as at the higher speed of 13,000 rpm. In most instances, the no. 559 bur was less efficient for removing enamel than the no. 37 bur. The single exception was when the no. 559 bur was operated under a load of 194.8 Gm. and at a speed of 4,000 rpm in which case there was no significant difference between the amount of enamel removed by either type of bur.

In cutting dentin with the ultrasonic dental unit under a constant load, 15 cuts were made with 15 different tips under a load of 194.8 Gm. For comparison, ten cuts each were made in dentin with nos. 559 or 37 carbide burs when under a load of 194.8 Gm. and at a speed of 4,000 rpm and when under a load of 116.8 Gm. and at a speed of 13,000 rpm. New burs were employed for each cut. There was some loss of the rotational speed of the bur when cutting in dentin at these weight loads. Under the conditions employed, the cutting capacity of the burs and the ultrasonic unit was not as great as when such instruments were manipulated by the operator (see Figure 2 and Table 1). In dentin, the cutting capacity of the carbide burs exceeded that of the ultrasonic unit even when the burs were rotated at a speed of 4,000 rpm. When identical loads were used, the

**Table 2** • Statistical analysis of the cutting efficiency of an ultrasonic dental unit and rotary burs under a constant load

| Type of instrument | Speed of rotation (rpm) | Load (Gm.) | Number of cuts | Type of tissue | Mean amount of tissue removed (mg.) | Range of amount of tissue removed (mg.) | Standard deviation | Standard error of mean | Coefficient of variation % |
|---|---|---|---|---|---|---|---|---|---|
| 1. Ultrasonic dental unit | | 116.8 | 10 | Enamel | 67.3 | 52.0– 92.9 | 14.14 | 4.473 | 21.0 |
| 2. Ultrasonic dental unit | | 194.8 | 10 | Enamel | 101.5 | 74.5–136.4 | 17.13 | 5.709 | 16.9 |
| 3. No. 559 carbide bur | 4,000 | 116.8 | 10 | Enamel | 7.4 | 4.9– 10.6 | 2.10 | 0.665 | 28.4 |
| 4. No. 559 carbide bur | 13,000 | 116.8 | 10 | Enamel | 61.5 | 37.9– 80.1 | 13.78 | 4.360 | 22.4 |
| 5. No. 559 carbide bur | 4,000 | 194.8 | 10 | Enamel | 8.4 | 5.9– 10.7 | 1.98 | 0.626 | 23.6 |
| 6. No. 37 carbide bur | 4,000 | 116.8 | 10 | Enamel | 11.0 | 6.8– 15.4 | 2.33 | 0.738 | 21.2 |
| 7. No. 37 carbide bur | 13,000 | 116.8 | 10 | Enamel | 81.5 | 54.9– 97.4 | 15.13 | 4.784 | 18.6 |
| 8. No. 37 carbide bur | 4,000 | 194.8 | 10 | Enamel | 7.9 | 2.9– 10.8 | 2.30 | 0.726 | 29.1 |
| 9. Ultrasonic dental unit | | 194.8 | 15 | Dentin | 57.2 | 41.9–101.2 | 14.47 | 3.737 | 25.3 |
| 10. No. 559 carbide bur | 4,000 | 194.8 | 10 | Dentin | 95.0 | 41.0–121.4 | 24.53 | 7.748 | 25.8 |
| 11. No. 559 carbide bur | 13,000 | 116.8 | 10 | Dentin | 285.5 | 237.4–381.4 | 42.00 | 13.299 | 14.7 |
| 12. No. 37 carbide bur | 4,000 | 194.8 | 10 | Dentin | 79.6 | 53.9–105.4 | 16.68 | 5.252 | 21.0 |
| 13. No. 37 carbide bur | 13,000 | 116.8 | 10 | Dentin | 173.2 | 143.9–201.2 | 18.87 | 5.969 | 10.9 |

Critical ratios for comparison of the various types of cutting instruments

| | | | | | |
|---|---|---|---|---|---|
| 1 vs 2 = 4.72 | 2 vs 4 = 5.59 | 3 vs 7 = 15.44 | 4 vs 11 = 16.00 | 6 vs 9 = 12.12 | 8 vs 11 = 20.87 |
| 1 vs 3 = 13.25 | 2 vs 5 = 16.19 | 3 vs 8 = 0.50 | 4 vs 12 = 2.50 | 6 vs 10 = 10.77 | 8 vs 12 = 13.53 |
| 1 vs 4 = 0.93 | 2 vs 6 = 15.71 | 3 vs 9 = 12.95 | 4 vs 13 = 15.09 | 6 vs 11 = 20.64 | 8 vs 13 = 27.46 |
| 1 vs 5 = 13.03 | 2 vs 7 = 2.68 | 3 vs 10 = 11.26 | 5 vs 6 = 2.68 | 6 vs 12 = 13.94 | 9 vs 10 = 4.39 |
| 1 vs 6 = 12.43 | 2 vs 8 = 16.25 | 3 vs 11 = 20.91 | 5 vs 7 = 15.10 | 6 vs 13 = 26.16 | 9 vs 11 = 16.54 |
| 1 vs 7 = 2.17 | 2 vs 9 = 6.49 | 3 vs 12 = 13.62 | 5 vs 8 = 0.52 | 7 vs 8 = 15.18 | 9 vs 12 = 3.47 |
| 1 vs 8 = 13.11 | 2 vs 10 = 0.68 | 3 vs 13 = 27.80 | 5 vs 9 = 12.88 | 7 vs 9 = 4.00 | 9 vs 13 = 16.45 |
| 1 vs 9 = 1.73 | 2 vs 11 = 5.81 | 4 vs 5 = 12.04 | 5 vs 10 = 11.13 | 7 vs 10 = 1.48 | 10 vs 11 = 12.37 |
| 1 vs 10 = 3.19 | 2 vs 12 = 2.82 | 4 vs 6 = 11.42 | 5 vs 11 = 20.83 | 7 vs 11 = 14.47 | 10 vs 12 = 1.64 |
| 1 vs 11 = 15.59 | 2 vs 13 = 8.68 | 4 vs 7 = 3.09 | 5 vs 12 = 13.46 | 7 vs 12 = 0.27 | 10 vs 13 = 8.00 |
| 1 vs 12 = 1.78 | 3 vs 4 = 12.24 | 4 vs 8 = 12.13 | 5 vs 13 = 27.80 | 7 vs 13 = 11.97 | 11 vs 12 = 14.44 |
| 1 vs 13 = 14.20 | 3 vs 5 = 1.11 | 4 vs 9 = 0.75 | 6 vs 7 = 14.54 | 8 vs 9 = 12.94 | 11 vs 13 = 7.69 |
| 2 vs 3 = 16.37 | 3 vs 6 = 3.60 | 4 vs 10 = 3.76 | 6 vs 8 = 3.00 | 8 vs 10 = 11.17 | 12 vs 13 = 11.76 |

Critical ratios of two or more are considered significant; if less than two they are considered not significant.

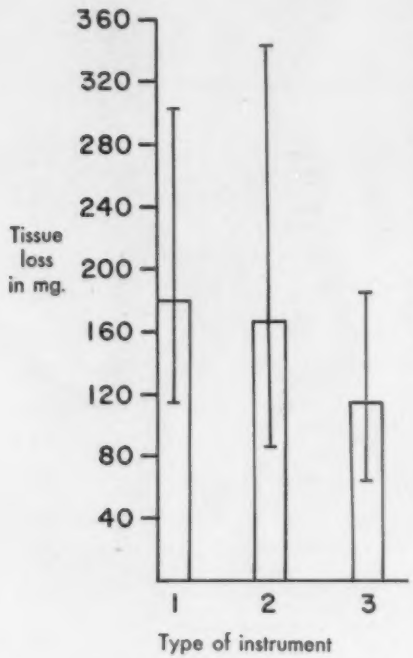


Fig. 4 • Mean and range in milligrams of quantity of tooth tissue from outer surface of enamel through dentinoenamel junction into dentin an operator was able to remove during a six minute cutting period. Various cutting instruments used on the tooth and conditions of cutting were as follows: (1) 20 different ultrasonic tips used to make 20 cuts (tips used: nos. 1-5, 11-14, 30-33, 40-42, 50, 51); (2) ten no. 559 steel burs used to make ten cuts at 4,000 rpm; (3) ten no. 701 steel burs used to make ten cuts at 4,000 rpm

ultrasonic unit cut significantly more slowly in dentin than in enamel.

*Cutting Rates of the Ultrasonic Dental Unit and Rotary Burs in Both Enamel and Dentin* • The cutting rates of the ultrasonic instrument and rotary burs, when manipulated by an operator so as to cut from the outer surface of the enamel toward the dentinoenamel junction into dentin, were determined for a six minute period. The data are summarized graphically in Figure 4 and analyzed statistically in Table 3. In the case of the ultrasonic unit, 20 different types of tips were used to make 20 separate cuts. Using burs, ten cuts each were made with nos. 559 and 701 steel burs rotating at 4,000 rpm. A new bur was used for each cut. On an average, the ultrasonic unit removed more of the calcified tissues than either the no. 559 or the no. 701 steel burs rotating at 4,000 rpm. However, the amount of tissue removed by the ultrasonic unit was not significantly different from the amount removed by no. 559 steel burs rotating at 4,000 rpm. No. 559 burs, on an average, removed more enamel and dentin than did the no. 701 burs.

*Cutting Rates of the Ultrasonic Dental Unit and Rotary Burs in Amalgam* • The cutting rates of the ultrasonic dental unit and burs when manipulated by an operator in amalgam fillings in extracted teeth were determined during a three minute period and the results shown in Figure 5 as the mean and range of the quantity of amalgam removed. In Table 4 the data have been subjected to statistical analysis. In cutting amalgam with the ultrasonic dental unit, 20 cuts each of three minutes duration were made with 13 different types of cutting tips. A new tip was used for each cut. In determining the cutting rate of burs, ten cuts each of three minutes duration were made with nos. 559 or 6 steel burs rotating at 4,000 rpm. A new bur was used for each cutting period. The ultrasonic unit was much less efficient for cutting amalgam than either no. 559 or no. 6 burs. The cutting rates of the two types of burs in amalgam were not significantly different.

*Cutting Rates of the Ultrasonic Dental Unit and Rotary Burs in Relation to Length of Use* • A test was made of the cutting efficiency of the ultrasonic dental unit and burs in relation to the length of time such instruments were used. Figure 6 shows the results of determining the cut-

**Table 3** • Statistical analysis of the cutting efficiency of an ultrasonic dental unit and rotary burs in both enamel and dentin

| Type of instrument | Speed of rotation (rpm) | Number of cuts | Type of tissue | Mean amount of tissue removed (mg.) | Range of amount of tissue removed (mg.) | Standard deviation | Standard error of mean | Coefficient of variation % |
|---|---|---|---|---|---|---|---|---|
| 1. Ultrasonic dental unit | | 20 | Enamel and dentin | 185.5 | 118.5–307.1 | 70.96 | 15.86 | 38.25 |
| 2. No. 559 steel bur | 4,000 | 10 | Enamel and dentin | 164.3 | 86.9–356.5 | 81.88 | 25.89 | 49.83 |
| 3. No. 701 steel bur | 4,000 | 10 | Enamel and dentin | 108.4 | 67.5–184.7 | 39.19 | 12.39 | 36.15 |

Critical ratios for comparison of the various types of cutting instruments

1 vs 2 = 0.70
1 vs 3 = 3.83
2 vs 3 = 2.01

Critical ratios of two or more are considered significant; if less than two they are considered not significant.

**Table 4** • Statistical analysis of the cutting efficiency of an ultrasonic dental unit and rotary burs in amalgam

| Type of instrument | Speed of rotation (rpm) | Number of cuts | Type of substance | Mean amount of substance removed (mg.) | Range of amount of substance removed (mg.) | Standard deviation | Standard error of mean | Coefficient of variation % |
|---|---|---|---|---|---|---|---|---|
| 1. Ultrasonic dental unit | | 20 | Amalgam | 318.0 | 70.5– 509.8 | 144.61 | 32.33 | 45.47 |
| 2. No. 559 steel bur | 4,000 | 10 | Amalgam | 1065.0 | 844.4–1203.4 | 117.64 | 37.20 | 11.05 |
| 3. No. 6 steel bur | 4,000 | 9 | Amalgam | 1025.7 | 829.7–1286.2 | 177.56 | 59.19 | 17.31 |

Critical ratios for comparison of the various types of cutting instruments

1 vs 2 = 15.15
1 vs 3 = 10.50
2 vs 3 = 0.56

Critical ratios of two or more are considered significant; if less than two they are considered not significant.

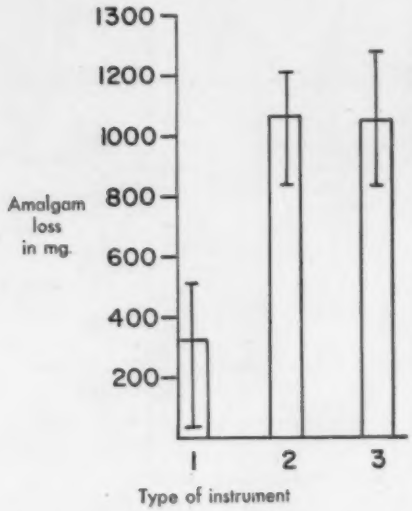


Fig. 5 • Mean and range of quantity of amalgam removed by operator during a three minute cutting period with ultrasonic unit and rotary burs. Cutting instruments and conditions of cutting were: (1) 13 different ultrasonic tips used to make 20 cuts (tips used: nos. 1-5, 11, 12, 30-33, 50, 51); (2) ten no. 559 steel burs used to make ten cuts at 4,000 rpm; (3) ten no. 6 steel burs used to make ten cuts at 4,000 rpm

ting rates in enamel of both the ultrasonic unit and burs when manipulated by an operator during one minute periods in sequence with an interval for weighing between each cutting period. In the case of the ultrasonic unit, four cuts each were made with four different types of tips at each time interval. The data for each time interval represent the mean amount of material removed by each of the four tips. The mean cutting efficiency of the ultrasonic dental instrument decreased from 61.5 mg. of tissue removed during the first minute of cutting to 15.0 mg. of tissue removed during the fifth minute of cutting. This is a decrease in cutting efficiency of over 76 per cent. With steel burs, the data for each time interval show the mean amount of enamel removed by five each of nos. 559 or 37 burs rotating at 4,000 rpm. The mean cutting efficiency of the burs decreased from 11.5 mg. of tissue removed at the first cutting period to 5.5 mg. of tissue removed at the fifth cutting period. This represents a decrease in the cutting efficiency of over 52 per cent.

The results of determining the cutting rate in dentin of the ultrasonic instrument and burs when manipulated by an operator during five one minute periods in sequence are shown in Figure 7. The cutting procedures with the ultrasonic dental instrument and burs were as described for enamel. In the case of the burs, the decrease in cutting rate was from a high of 75.0 mg. of dentin re-

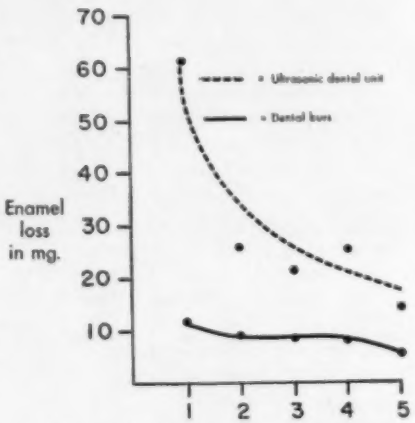


Fig. 6 • Mean quantity of enamel (in milligrams) that operator was able to remove by the use of ultrasonic dental unit or steel burs during one minute periods in sequence for a total cutting period of five minutes. Amount of tissue removed was determined in the interval between each one minute cutting period. The experiment was designed to relate cutting efficiency in enamel with length of time the tool was used. For the ultrasonic unit, data for each interval of time represent mean amount of enamel removed in milligrams by four each of four different types of tips (tips used: nos. 30, 32, 33, 50). For steel burs, data for each time interval represent mean amount of enamel in milligrams removed by five each of nos. 559 and 37 burs while making five separate cuts with each bur

moved during the first minute to 53.0 mg. removed during the fifth minute. This represents a decrease of over 29 per cent in cutting efficiency during the five minute period. In the case of the ultrasonic unit cutting dentin, the decrease was from a high of 40.0 mg. of dentin removed during the first minute of cutting to 10.0 mg. removed during the fifth minute of cutting. This represented a decrease in cutting efficiency of 75 per cent during the five minute period.

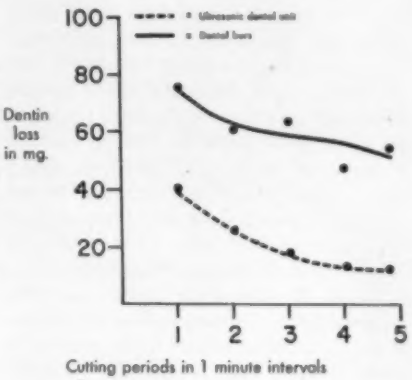


Fig. 7 • Mean quantity of dentin (in milligrams) that operator was able to remove by use of ultrasonic unit or steel burs during one minute periods in sequence for a total cutting period of five minutes. Amount of tissue removed was determined in the interval between each one minute cutting period. Experiment was designed to relate cutting efficiency in dentin with length of time tool was used. In the case of the ultrasonic unit, data for each interval of time represent mean amount of dentin removed by four each of four different types of ultrasonic tips (nos. 30, 32, 33, 50). For steel burs, data for each time interval represent mean amount of dentin removed by five each of nos. 559 and 37 burs rotating at 4,000 rpm while making five separate cuts with each bur

## DISCUSSION

Other workers[24] have advocated the use of materials such as Ivorene, a synthetic ivory whose hardness is more comparable to dentin than enamel, for determining the cutting characteristics of burs because they are supposedly more uniform and homogeneous than enamel and dentin. It is conceded that such an approach is useful for determining certain of the cutting characteristics of burs, but it seems not only useful but necessary for comparative purposes to determine the cutting rates of burs and other cutting tools in enamel, dentin, or filling material even though such substances may not be homogeneous. Furthermore, it seems both useful and necessary for comparative purposes to determine where possible the cutting characteristics of dental cutting tools both under standardized conditions and in the hands of an operator, even though variations may be introduced by the use of such methods.

In the present study these variations are accounted for by making a statistical comparison of the data obtained by the various methods. It is not possible, however, to determine precisely whether the variations seen are caused principally by the method used to make the cut, that is, operator or machine to apply a constant load, or because of variations in enamel or dentin. Nevertheless, by a statistical analysis of the data, certain valid conclusions can be made.

The ultrasonic dental unit when manipulated by an operator in enamel so as to cut at maximum efficiency exceeded the cutting rate of steel burs rotating at either 4,000 rpm or 13,000 rpm when manipulated by the same operator. Under similar conditions, carbide burs rotating at 13,000 rpm removed considerably more enamel than did either the ultrasonic unit or the steel burs. The no. 559 and no. 37 steel burs differed significantly in their cutting efficiency in enamel when rotating at the same speed. Similar types of carbide burs did not differ significantly in their cutting efficiency. When the ultrasonic unit and burs were applied to dentin, the cutting efficiency

24. Henry, E. E., and Peyton, F. A. Study of the cutting efficiency of dental burs for the straight handpiece. J. D. Res. 30:854 Dec. 1951.

of all the burs exceeded that of the ultrasonic unit. In cutting dentin with steel burs, increasing the speed from 4,000 rpm to 13,000 rpm increased their cutting efficiency more than when similar changes in speed were made in cutting enamel. Because of technical difficulties, exact comparisons could not be made of the cutting efficiencies of carbide burs in dentin; however, such burs when rotating at 13,000 rpm cut dentin efficiently.

When the ultrasonic dental unit was subjected to a constant load of 116.8 Gm. it did not cut as efficiently in enamel as when it was manipulated by an operator. When the load was increased to 194.8 Gm. the ultrasonic unit cut more rapidly than when it was manipulated by an operator. When carbide burs were subjected to constant loads of either 116.8 or 194.8 Gm., they did not perform as efficiently as they did in the hands of an operator. Apparently these pressures did not compare favorably with that applied by an operator. Under any circumstances, the carbide burs did not perform as efficiently at 4,000 rpm as they did at the higher speed of 13,000 rpm. Both the ultrasonic unit and carbide burs cut more efficiently in enamel under a constant load of 194.8 Gm. than when manipulated by an operator. In both enamel and dentin the cutting rate of the ultrasonic unit compared favorably to that of steel burs rotating at 4,000 rpm. In amalgam, however, the ultrasonic dental unit did not perform as well as the steel burs that were tested.

The cutting efficiency of burs decreases with use because of dulling or loss of cutting edges. The loss of efficiency of such burs is also related to their composition, type of material being cut, and the amount of heat generated. Perhaps speed of rotation also relates to loss of efficiency. It might be suspected that within reason, however, the cutting efficiency of an ultrasonic cutting tool would not decrease greatly with the length of time that the tool was used, for dulling or loss of the cutting edge should not be an important factor. When tested in enamel, however, the ultrasonic dental unit not only lost cutting efficiency more quickly than did steel burs but it lost more over-all cutting efficiency than the burs during the entire five minute cutting periods. The ultrasonic unit did not lose cutting efficiency as rapidly during the latter part of the five minute test period as it did during the early part, particularly during the first minute. The ultrasonic unit also lost cutting efficiency rapidly when cutting dentin. In both enamel and dentin the over-all loss of cutting efficiency was about 75 per cent. The steel burs did not lose cutting efficiency in dentin as rapidly as the ultrasonic device; their over-all loss in cutting efficiency was about 29 per cent. The loss in cutting efficiency sustained by ultrasonic cutting tools has also been observed previously by Nielsen.[7]

*The Challenge of Science* • The pursuit of science presents to the human mind an enduring challenge on an endless frontier, quite apart from the material enrichment of mankind to which it may incidentally give rise. *Sir Edward Appleton.*

# Microbiologic hazards of local dental anesthesia
## II. Pilot study of involuntary aspiration of bacteria into hypodermic needles and anesthetic cartridges after injection

*Murray M. Streitfeld,* Ph.D., and Doran D. Zinner,† D.D.S., Miami, Fla.*

A major hazard exists when anesthetic cartridges are used for injections in more than one patient. It has long been known that syringes contaminated by involuntary aspiration may be the means of transmission of pathogenic microorganisms from patient to patient.[1,2] Editorials in *The Journal of the American Medical Association*,[3] the *British Medical Journal*,[4] *The New England Journal of Medicine*,[5] and *The Journal of the American Dental Association*[6] summarized and highlighted certain methods of virus transmission in homologous serum jaundice (serum hepatitis). These editorials emphasized the minute quantities of virus required to transmit infection. Thus, inadequately sterilized needles or syringes, contaminated by a previous injection in a patient carrying hepatitis virus, were capable of passing the virus to the recipients of successive injections. Possible transmission of microbial agents by inadequate sterilization technics of materials used for local anesthesia has been emphasized recently in a report by Foley and Gutheim,[7] suggesting that transmission of serum hepatitis may occur through contaminated needles, syringes or anesthetic solution.

The possibility of transmission of another virus, poliomyelitis, by contaminated needles and syringes, has been reviewed by Faber[8] and by Lenard.[9]

The present experimental study has demonstrated that microorganisms can be sucked back into anesthetic cartridges, so that re-use of the cartridges will result in microorganisms from one patient being forced into the tissues of subsequent patients.

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*Bacteriologist, department of medical research, National Children's Cardiac Hospital, and assistant professor, department of bacteriology, School of Medicine, University of Miami.

†Director, department of dental research, National Children's Cardiac Hospital, and research assistant professor, department of microbiology, University of Miami.

1. Capps, R. B.; Sborov, Victor, and Scheiffley, C. S. Syringe-transmitted epidemic of infectious hepatitis with observations regarding the incidence and nature of infectious donors. J.A.M.A. 136:819 March 20, 1948.

2. Wilson, G. S., and Miles, A. A. Topley and Wilson's Principles of bacteriology and immunity, vol. 2, ed. 4. Baltimore, Williams & Wilkins, 1955, p. 2207, 2209.

3. Syringe transmitted hepatitis. Editorial. J.A.M.A. 129:278 Sept. 1945.

4. Syringes, serum, and jaundice. Editorial. Brit. M. J. 1:810 June 1945.

5. Syringe-transmitted hepatitis. Editorial. New England J. Med. 239:70 July 8, 1948.

6. Viral hepatitis: guard against its transmission. Editorial. J.A.D.A. 55:87 July 1957.

7. Foley, F. E., and Gutheim, R. N. Serum hepatitis following dental procedures: a presentation of 15 cases, including three fatalities. Ann. Int. Med. 45:369 Sept. 1956.

8. Faber, H. K. Postinoculation poliomyelitis. Editorial. Pediatrics 7:300 Feb. 1951.

9. Lenard, A. Poliomyelitis; possibility of syringe transmission. M. Times 79:395 July 1951.

This report presents the results of a preliminary investigation[10, 11] designed:

1. To determine whether there is an involuntary aspiration created in the anesthetic cartridge or in the hypodermic needle or both when tested in vitro and in vivo.

2. To determine qualitatively and quantitatively the bacterial flora which may be recovered from needles and cartridges after the common dental procedure of introduction of sterile cartridge-syringe needles into the nonsterilized oral mucous membrane.

3. To ascertain the efficacy, and the problems attendant on its use, of one antibacterial compound, mercocresol mixture (Mercresin) in the topical disinfection of oral mucosae prior to injection for anesthesia.

## METHODS

*Determination of Involuntary Dye Aspiration into Needles and Cartridges* • Aspiration of a dye solution into hypodermic needles and cartridges was investigated for five different brands of cartridges containing anesthetics commercially packaged in 1.8 to 2.2 cc. quantities. The anesthetic solutions tested were metabutoxycaine hydrochloride (Primacaine Hydrochloride), meprylcaine hydrochloride (Oracaine Hydrochloride), procaine hydrochloride with butethamine hydrochloride (Duocaine Hydrochloride), lidocaine hydrochloride (Xylocaine Hydrochloride), and procaine hydrochloride with propoxycaine hydrochloride (Ravocaine Hydrochloride).

In order to ascertain the effect of the different gauges and lengths of hypodermic needles on dye aspiration, a separate needle was used for each cartridge tested. Needles of 25, 27 and 30 gauge, 1 and 1⅝ inches in length were used. The hypodermic needle attached to a loaded syringe was held below the surface of a 1 per cent aqueous solution of crystal violet in an open beaker while approximately 0.5 ml. of anesthetic solution was expelled from the cartridge by the syringe plunger. Positive pressure was released, the syringe was lifted from the beaker of dye solution, and the cartridge was examined for visible dye aspiration. Aspiration of dye solution into the hypodermic needle was determined by wiping the outer surface of the needle free of dye, then slowly ejecting 1 to 2 drops of anesthetic from the needle, and examining the drops for dye coloration against a white background. Figure 1 illustrates a typical syringe showing the dye in the cartridge, as well as in the partially expelled needle contents.

*Injection Procedure, and Determination of Involuntary Bacterial Aspiration into Hypodermic Needles and Syringes* • This phase of the investigation was performed during dental practice. Injections were given by needles and syringes that had been sterilized by autoclaving for 20 minutes at 120° C. under 15 pounds pressure. Anesthetic cartridges were kept half immersed, needle side down, in a beaker of 70 per cent methanol. Each cartridge was removed, and the adherent alcohol flamed from it immediately prior to its use in a sterile cartridge syringe. Flaming was performed in order to destroy bacterial or fungal spores not readily killed by cold methanol.

One antiseptic, tincture of mercocresol mixture, and one anesthetic, metabutoxycaine hydrochloride, were used throughout this phase of the study. The antiseptic was applied by a sterile cotton applicator either directly to the unprepared mucous membrane, or to mucosae after wiping away the mucus from the injection site with a dry sterile swab. The

10. Zinner, D. D., and Streitfeld, M. M. Bacteriologic dangers of local dental anesthesia. Preprinted abstracts, International Association for Dental Research, thirty-fifth general meeting, March 21-24, 1957, Atlantic City, N. J., p. 63.

11. Streitfeld, M. M., and Zinner, D. D. Microbiologic problems in the injection of local dental anesthetics. Presented before the South Florida Branch of the Society of American Bacteriologists, Coral Gables, Fla., May 25, 1957.

antiseptic was left on the mucosa for various intervals of time (0 to 5, 15, 30 and 60 seconds) before injection of anesthetic. In controls, no antiseptic was employed. No more than three quarters of the contents of an anesthetic cartridge was injected per patient in this study.

Two types of injections (blocks and infiltrations) were administered in various sites of the oral cavity. Immediately after injection of the anesthetic solution, the first two drops from the needle were expressed onto the surface of a plate of sterile neopeptone infusion agar (Difco), enriched with 4 per cent sheep's blood. The two drops were then streaked out with a sterile wire loop. The cartridge was removed from the syringe used for injection, placed into another sterile syringe, and the remaining contents were expelled into a tube containing 10 ml. of Todd-Hewitt broth (Difco) enriched with 4 per cent sheep's blood. Both plate and tube were incubated at 37° C. for approximately 24 hours. A bacterial colony count then was done on the plate, as well as a tentative identification by colony morphology, type of hemolysis, and reaction to gram stain of the various bacteria growing on the plate surface. Figure 2 illustrates an incubated Petri dish showing the appearance of colonies after inoculation of the plate surface with two drops of a needle's contents after injection of anesthetic into a subject.

The tube containing broth and anesthetic solution was examined for turbidity, as gross evidence of bacterial growth. Samples were checked for bacterial content by streaking a loopful of the contents on a sterile blood-agar plate. Bacterial colonies on this culture medium after 24 hours' incubation at 37° C. were identified tentatively by the procedure described.

## RESULTS

The five different commercial brands of anesthetic cartridges were compared with respect to dye solution aspirated into the cartridges and into hypodermic needles after the contents of representative samples of these cartridges were partially expelled into dye solution contained in an open beaker. Dye solution was sucked back into the needle contents in every instance of 113 separate trials with that number of cartridges involving all brands of cartridges tested.

Fig. 1 • Dye aspiration into hypodermic needle and anesthetic cartridge, after expulsion of anesthetic into beaker of dye while injection needle was held below dye surface. Note dye concentrated in partially expelled needle contents (a) and dispersing in cartridge (b). (Approximately half size)

The percentage of cartridges demonstrating visible dye aspiration varied with the commercial brand; these percentages were (1) 100 per cent (25 in 25 trials) for metabutoxycaine hydrochloride, (2) 76 per cent (10 in 25 trials) for meprylcaine hydrochloride, (3) 28 per cent (7 in 25 trials) for procaine hydrochloride with butethamine hydrochloride, (4) 20 per cent (5 in 25 trials) for lidocaine hydrochloride, and (5) 0 per cent (0 in

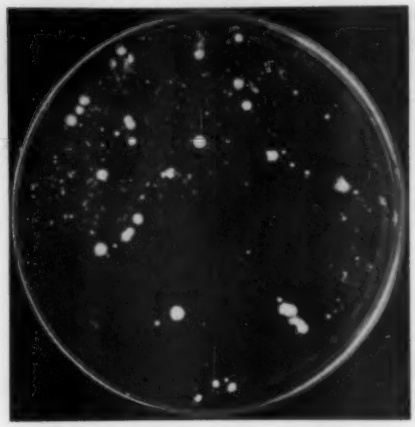

Fig. 2 • Typical bacterial growth (on neopeptone infusion agar enriched with 4 per cent sheep's blood) after inoculation of Petri plate agar surface with first two drops of anesthetic in needle after injection into patient whose oral mucosa was not prepared with antiseptic. Note diversity of bacterial colonies found to grow from needle contents. (Sixty-six per cent of original size)

13 trials) for procaine hydrochloride with propoxycaine hydrochloride. Neither the needle gauge nor length, among those needles sampled, appeared to influence the percentage of aspiration of dye solution into needles or cartridges.

Table 1 presents the results of studies of the bacterial content of hypodermic needles used on patients whose oral mucosae were prepared by various procedures for injections from anesthetic cartridges. Injection into the unprepared mucosae resulted in the highest percentages of infected needles, from which were obtained bacterial colony plate counts of 3 to 24 colonies (13 of 38 injections, or 34.2 per cent), or 25 or more colonies (15 of 38 injections, or 39.4 per cent). Preparation of the injection site by wiping away the saliva with a dry sterile swab reduced these percentages for 25 or more colonies (3 of 21 injections, or 14.3 per cent) and for 3 to 24 colonies (5 of 21 injections, or 23.8 per cent). Antiseptic applied to the mucosae 15 seconds before anesthetic injection had approximately the same effect in lowering the needle content of bacteria that could be cultured. Bacterial counts were reduced to 2 or less colonies per plate from needle content in 95 per cent (19 of 20) of the trials only after the antiseptic was permitted to remain in contact with the injection site for one minute. Similarly low bacterial counts were observed when injections were performed immediately after application of antiseptic, provided the mucosae were first wiped free of saliva. Seventy-five per cent (15 of 20) of these injections using the combined procedure resulted in colony counts of 0 to 2 colonies, whereas counts of 3 to 24 colonies were obtained from the other 25 per cent (5 of 20) of the injections.

Table 2 presents the numbers and percentages of cartridges from whose remaining contents bacterial growth could be demonstrated, after 151 oral injections. The data are tabulated so as to indicate the relative effectiveness of different methods of preparation of oral injection sites in lowering the number of bacterially contaminated cartridges.

The percentage of cartridges from whose remaining anesthetic content bacterial growth was obtained was highest (21 of 38 cartridges, 55.3 per cent) when the injection site was not prepared, and dropped in percentage when various preoperative procedures were employed. Thus, simple wiping of the mucosa with a dry sterile swab prior to injection of anesthetic lowered the percentage of infected cartridges to 33.3 per cent (7 of 21 cartridges); antiseptic applied to the injection site for one minute further lessened the percentage to 15 per cent (3 of 20 cartridges). The lowest per cent of cartridges (7.1 per cent or 2 of 28) infected through involuntary aspiration of bacteria was obtained by the combination of wiping the mucosa with a dry sterile swab and permitting the antiseptic to remain in contact with the mucosa for

**Table 1** • Involuntary bacterial aspiration into hypodermic needles, after 123 oral injections into patients. Bacterial colony counts of the needle contents cultured on neopeptone infusion agar enriched with 4 per cent sheep's blood

| Antiseptic* | No. injections | No. and % of injections resulting in plate colony counts of: | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0-2 | | 3-24 | | 25+ | |
| | | No. | % | No. | % | No. | % |
| None | 38 | 10 | 26.4 | 13 | 34.2 | 15 | 39.4 |
| None + st. swab† | 21 | 13 | 61.9 | 5 | 23.8 | 3 | 14.3 |
| Antiseptic 0-5 seconds‡ +st. swab | 20 | 15 | 75.0 | 5 | 25.0 | 0 | 0 |
| Antiseptic 15 seconds | 24 | 16 | 66.7 | 2 | 8.3 | 6 | 25.0 |
| Antiseptic 1 minute | 20 | 19 | 95.0 | 1 | 5.0 | 0 | 0 |

*Antiseptic used was 1:1,000 mercocresol mixture.
†"St. swab" indicates that saliva was wiped from injection site with dry sterile swab before injection.
‡Dental injection was performed as soon as possible after application of antiseptic to injection site.

15 seconds, prior to injection of the anesthetic.

Alpha-hemolytic streptococci comprised the majority of bacterial colonies growing on the agar medium. They were either primary cultures from the contents of needles after injections, or subcultures of blood broth cultures made from the contents of cartridges after injections. However, a wide range of other types of microorganisms were seen, including gamma-hemolytic streptococci, staphylococci, gram-positive and gram-negative bacilli, and occasional yeast cells.

## DISCUSSION

Microbiological infection of a patient, or the transmission of pathogenic bacteria from patient to patient, may occur during the procedures attending injection of local dental anesthetics. The sterilization technics used for hypodermic needles, syringes and cartridges may be unsatisfactory, and the procedures for prior preparation of the oral mucosae at the sites of injection of anesthetic may be inadequate at times. Adequate antisepsis and asepsis of local anesthetic injections

**Table 2** • Percentage of anesthetic cartridges demonstrating bacterial aspiration after 151 oral injections into patients

| Antiseptic* | No. injections | Bacterial growth from cartridges | | | |
|---|---|---|---|---|---|
| | | Cartridges positive | | Cartridges negative | |
| | | No. | % | No. | % |
| None | 38 | 21 | 55.3 | 17 | 44.7 |
| None + st. swab† | 21 | 7 | 33.3 | 14 | 66.7 |
| Antiseptic 15 seconds | 24 | 4 | 16.7 | 20 | 83.3 |
| Antiseptic 1 minute | 20 | 3 | 15.0 | 17 | 85.0 |
| Antiseptic 0-5 seconds‡ +st. swab | 20 | 2 | 10.0 | 18 | 90.0 |
| Antiseptic 15 seconds +st. swab | 28 | 2 | 7.1 | 26 | 92.9 |

*Antiseptic used was 1:1,000 mercocresol mixture.
†"St. swab" indicates that injection site was wiped relatively free of saliva with dry sterile swab before injection.
‡Oral injection was here performed as soon as possible after application of antiseptic to injection site.

have been seen to consist of at least three phases: (1) preparation of the site of injection, (2) sterility of needle and syringe, and (3) sterility of the solution injected.[12]

In order to ascertain the technic in common practice, 1,272 practicing dentists at locations throughout one state were surveyed[10,11,13] by means of a Mimeographed questionnaire; 666 dentists (52.4 per cent of those questioned) returned completed survey forms. Evidence was presented that these dentists graduated from 81 different dental schools and represented, in educational background, all geographical areas of the country.

The results disclosed that a minimum of 11.9 per cent of the dentists answering the survey do not attempt any sterilization of oral injection sites routinely, and only 42.5 per cent of the dentists indicated that they use surface antiseptics routinely prior to local injection. Peecook,[14] recently reporting experiments on the results of injection of anesthetics from cartridges into a vessel of ink, indicated that there was aspiration of fluid into the needles and cartridges. However, the survey[13] showed that approximately 88 per cent of the dentists use the same anesthetic cartridge for more than one injection in the same patient, and 31.4 per cent of the dentists said that they occasionally used the same cartridge on more than one patient.

The survey indicated the urgent need for reconsidering the technics required for prophylaxis against postinjection infection. An excellent review[15] of procedures for adequate sterilization of dental instruments has been published recently.

A variety of bacteria, actually or potentially pathogenic, are always present on the oral mucosae through which the local anesthetic must be injected.[12] The study here reported has demonstrated that there is involuntary aspiration of bacteria both into the needles and the anesthetic cartridges in oral injection procedures.

Preparation of the injection site with antiseptics can decrease the extent to which viable microorganisms are sucked back into both needles and cartridges. A combined procedure wherein the injection site is wiped free of adherent mucus with a dry sterile swab before the antiseptic is applied lowers the relative number of living microorganisms to an even greater degree. Wiping of the oral mucosa with a sterile swab may have two effects: (1) it removes large numbers of microorganisms trapped in the mucus and saliva (which contain an average of 750,000,000 bacteria per cubic centimeter[16]) that might be introduced into the mucosal tissue when the anesthetic injection is given, or might be sucked back when the needle is removed from the mucosa, and (2) it mechanically removes saliva and mucus, thus permitting better penetration of the antiseptic for disinfection of the surface of the injection site.

The quantitative enumeration of viable bacteria that may be cultivated from within the needles after their use permits the comparison of results obtained in studies of large numbers of patients. However, colony counts from individual needles by the technic here followed were subject to modification by many factors. Such factors included differences in cleanliness of sites injected; inequalities in the size of the drops measured for bacterial counts from different gauge needles; differing abilities of particular

12. Appleton, J. L. T. Bacterial infection; with special reference to dental practice, ed. 4. Philadelphia, Lea & Febiger, 1950, p. 126, 127.

13. Zinner, D. D., and Streitfeld, M. M. Microbiologic hazards of local dental anesthesia. I. State-wide survey of procedures in common practice. J.A.D.A. 56:508 April 1958.

14. Peecook, W. L. Dangers in cold sterilization of needles. D. Digest 62:112 March 1956.

15. Maurice, C. G. Critical survey of methods of instrument disinfection and sterilization. J.A.D.A. 55:527 Oct. 1957.

16. Appleton, J. L. T. Bacterial infection; with special reference to dental practice, ed. 4. Philadelphia, Lea & Febiger, 1950, p. 412.

microorganisms to multiply on the culture media used; and possible adherence of microorganisms to the wire loop used in streaking the primary isolation plates of agar. The enumeration procedure here employed indicated relative differences in the number of viable organisms that were found to be sucked back into injection needles after various preparative procedures on the injection sites.

The procedure required to prepare plates for bacterial counts from contaminated cartridges was considerably less difficult than in preparation for the enumeration of the bacterial flora in aspirated needle contents. Differences in sepsis at various sites in the same or in different patients' mouths also might affect the results obtained with anesthetic cartridges. Such differences, however, would be expected to cancel out in the study of a large series of patients. Clear-cut differences were demonstrable in the numbers of bacterially contaminated anesthetic cartridges after their use in patients whose mucosal injection sites were prepared by different procedures.

The microbiological culturing methods used in the present study were adequate only for the growth of certain bacteria and fungi, but not for others having more fastidious cultural requirements (that is, species of Hemophilus, Brucella, Spirillum and so forth), and not for viral agents. A wide variety of other microbial agents, other than those demonstrable on neopeptone infusion agar enriched with 4 per cent sheep's blood, may be present in the aspirated contents of needles and cartridges. Studies designed to demonstrate and to identify such agents are now in progress.

The present study has called attention to many of the potential hazards attending injections of anesthetics into oral tissues. One survey of the literature has indicated that many postinjection infections are on record, the actual number probably being much greater than the number published.[12] We would like to call attention to the risk that attends injections into a patient when the injection site is inadequately disinfected, even when an adequately sterilized needle and syringe and a fresh sterile anesthetic cartridge are employed. When microbial aspiration into the needle or cartridge or both has occurred, either the primary injection or successive injections may lead to the introduction of microorganisms from the patient's own mouth into deep tissues.

Microorganisms inserted into tissues may initiate local or systemic pathological processes.[12] One complication presented by such organisms has been recognized in the recommendation of the American Heart Association[17] that patients who have rheumatic or congenital heart disease receive antibiotic prophylaxis prior to undergoing dental manipulation. This treatment is intended to prevent the possible development of subacute bacterial endocarditis by organisms lodging on the heart valves during the period of transient bacteremia. Microorganisms injected into the oral mucosa may set up local infections in the mucosal tissues, may be the causal agents of systemic disease, or may initiate infections at sites in the host that are far-removed from the area of injection.

Our considered recommendation is as follows:

1. Oral mucosa, to be prepared adequately for hypodermic procedures, should be

   a. Wiped free of overlying saliva and mucus with a dry sterile swab.

   b. Treated with a surface antiseptic.

2. Cartridges never should be re-used. Re-use could be prevented by employing sterile, disposable combined needle-anesthetic cartridge preparations, each to be used for a single injection, then discarded.

17. Prevention of rheumatic fever and bacterial endocarditis through control of streptococcal infections. Mod. Concepts Cardiovas. Dis. (Suppl.) 25:365 Dec. 1956.

Clinical and laboratory investigations now in progress include examinations of blood cultures obtained from patients after oral injections of anesthetic solutions, studies of the relative effectiveness of different topical antiseptics in the disinfection of oral mucosae, investigation of the cytotoxic effects of different anesthetic solutions, and studies of involuntary aspiration of pathogenic viral agents into hypodermic needles and anesthetic cartridges.

SUMMARY

Involuntary aspiration of microorganisms into hypodermic needles and anesthetic cartridges used for local dental anesthesia has been investigated in vitro and during dental practice.

Five different commercial brands of anesthetic cartridges were compared with respect to aspiration of dye solution into the cartridges and into needles when the anesthetics were partially expelled, subsurface, into dye solution contained in an open vessel. Dye solution was sucked back into the needles in every instance. However, the different commercial brands of anesthetics varied in the percentage of cartridges tested that showed aspiration of dye.

Gross contamination of needles by bacteria was found to occur in a high percentage of injections (using one brand of anesthetic cartridge) when the mucosal sites were not prepared for injections by the use of a surface antiseptic. Bacterial contamination could be reduced by wiping the mucous membrane free of mucus with a sterile swab, or by use of antiseptic (tincture of mercocresol mixture) on the mucosa prior to injection. The greatest reductions in bacterial contamination of needle contents was observed when the antiseptic was permitted to remain in contact with the mucosa for one minute before injection of anesthetic, or when the combined procedure was employed of wiping the injection site with a dry sterile swab, prior to the use of local antiseptic for a few seconds before injection.

Bacterial contamination of cartridges through involuntary aspiration (using the same brand of anesthetic cartridges) was found in the greatest number (55.3 per cent) when the injection site was not prepared, and less frequently when various preinjection procedures were employed. A combined treatment, in which antiseptic was left in contact with the mucosa for 15 seconds after the site of injection was cleansed with a dry sterile swab, gave the lowest per cent (7.1 per cent) of cartridges that became positive through bacterial aspiration.

The results and implications of this study are considered from the standpoints of: (1) the need for preinjection preparation of the mucosae, for prophylaxis against infection, and (2) the hazards of transmission of pathogenic microbes, both through the use of inadequately sterilized hypodermic needles and syringes, and through the re-use of anesthetic cartridges.

*School and Home* • No school can offset the evil influence not merely of a bad home but of a home with low moral, disciplinary and intellectual standards.

If fathers and mothers offer their children no more intellectual fare than comic books, television sets and picture magazines; if they make of the home merely a place to sleep, drink and eat—and not the center of life—they have no right to complain of the schools. *Grayson Kirk. Address before the National Education Association.*

# Effect of roentgen-ray irradiation from a modern dental x-ray unit on the red and white blood cell count and on growth in the rat

*Thomas D. Marshall, D.D.S., M.S.; Lewis B. Spear, D.D.S., and Joseph C. Muhler, D.D.S., Ph.D., Indianapolis*

During the past decade there has been increasing interest in the potentially harmful effect of too frequent exposure to roentgen rays. The dental profession has been specifically implicated by some workers since many members of the profession advocate yearly roentgen-ray examination.

The number of dental roentgenograms taken by American dentists in the course of a year is enormous. It has been estimated that during the week of April 16 to 22, 1950, 1,600,000 roentgenograms were taken.[1] The problem is complicated by the increased exposure of the body to roentgen-ray radiation as a result of atomic and hydrogen bomb tests. Taken collectively, some geneticists[2] have expressed concern that the benefits derived through dental use of roentgen rays are not compensated for by the harmful effects which will result to further generations. However, recent evidence by Budowsky and others[3] has indicated that no significant hematologic changes of clinical importance were noted between findings before and after exposure to a full mouth roentgenographic examination consisting of 14 periapical roentgenograms.

In order to gain more knowledge specifically concerning the effects of roentgen-ray irradiation produced by a dental x-ray unit, a study of the total red and white blood cells of rats before and after exposure to roentgen rays was conducted. This preliminary work involved a study of the effects of irradiation on growth and on the red and white blood cells of the rat, since changes in the blood pictures are known to occur with as small an amount of radiation as 5 r,[4] and thus may be considered a sensitive indicator of radiation.

## METHODS AND PROCEDURES

Twenty weanling Sprague-Dawley strain albino rats were used in the study. They were divided equally into two groups, each group containing five males and five females. Each of the rats composing

This work was supported in part by a grant, no. DA-283, from the U. S. Public Health Service.

From Indiana University, School of Dentistry.

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3. Budowsky, Jack, and others. Lack of effect of exposure to radiation during intraoral roentgenographic examination as evidenced by postexamination blood studies. J.A.D.A. 55:199 Aug. 1957.

4. Suter, G. M. Response of hematopoietic system to x-rays. U. S. Atomic Energy Commission Report MDDC 824. Oak Ridge, Tenn., U. S. Atomic Energy Commission, 1947.

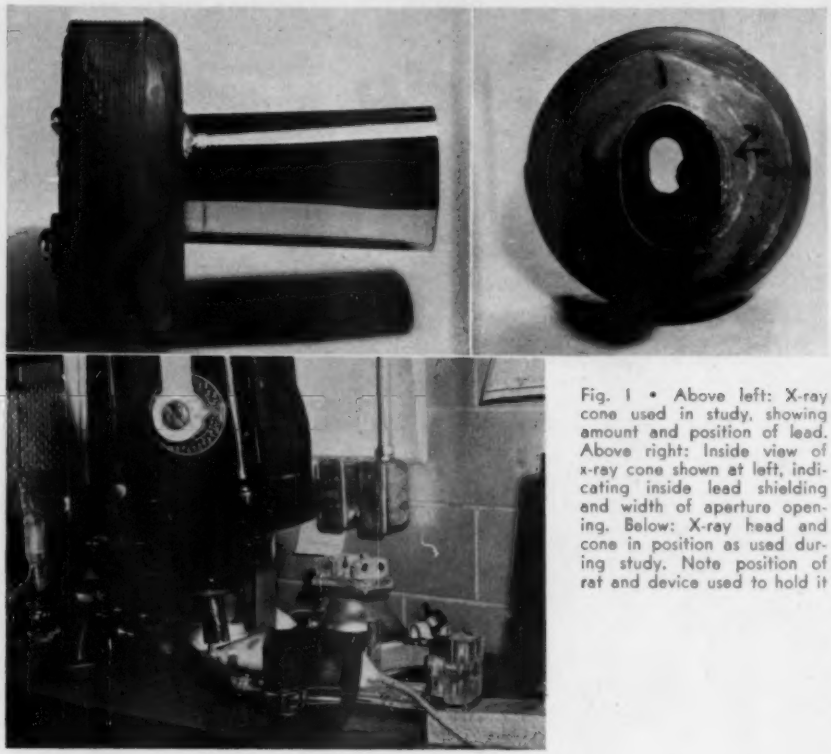

Fig. 1 • Above left: X-ray cone used in study, showing amount and position of lead. Above right: Inside view of x-ray cone shown at left, indicating inside lead shielding and width of aperture opening. Below: X-ray head and cone in position as used during study. Note position of rat and device used to hold it

Group 1 was exposed to a total dose of 2,016 r. The animals in Group 2 were not irradiated and served as controls. All the animals received the same stock corn diet and tap water. They were housed individually in raised screen cages.

The roentgen-ray dosage was arrived at by taking 12 full mouth exposures at 141 r per examination throughout the experimental period of 72 weeks. In addition, 24 complete posterior bitewing exposures were made at 13.5 r per examination. These values were arrived at since it was felt that the average dental patient would be exposed to approximately one full mouth examination every four years and two posterior bitewing examinations at intervals between each full mouth examination. The rats were exposed to 141 r once every six weeks, and to 13.5 r at two week intervals between the 141 r exposure. This interval of exposure was arrived at to correspond to the roentgen-ray examination schedule normally practiced for the dental patient, on the basis of the calculation that one week in a rat's life corresponds to 34 weeks in a human being.

The roentgen-ray source used in this study was a Myer dental x-ray unit. The kilovolt peak used was 63, the milliamperage was 5, and the roentgen output per minute at a 7 inch focal-skin distance in air was 166. Figure 1, above, shows how the machine was collimated so as to expose the rat's face in proportion to that properly exposed during dental roentgen-ray procedures on the human face. The

tube housing was lined with lead shielding to prevent radiation leaks. Figure 1, below, shows the special equipment that was constructed to position and retain the rat's head properly during each exposure.

Blood samples were taken from each of the animals in both series every time they were irradiated throughout the entire experimental period of 72 weeks. At each of the intervals when the animals were irradiated a white and red blood cell count was taken immediately before irradiation. After irradiation white blood cell counts were made at 2, 4 and 24 hour periods. While the rat was kept under light ether anesthesia, blood for the red and white cell counts was obtained from the tip of the tail. The total erythrocytes were counted by the method described by Wintrobe,[5] which consists essentially of dilution of the whole blood with Hayem's solution and counting the cells in a Bright-Line Counting Chamber, Double Improved Neubouer Ruling. The total leukocytes were counted by the method described by Wintrobe, which consists of diluting the whole blood with 3 per cent acetic acid and counting the cells in the same chamber as used for the erythrocytes.

## DATA AND DISCUSSION

The data from these investigations are found in Figures 2 through 7. The weights of the two groups are seen in Figure 2, and the data indicate that up to a period of 36 weeks, no significant weight differences were evident. However, from 36 weeks until the end of the study at 72 weeks, the experimental group fell slightly behind the control group in weight increases. The control animals were handled exactly in the same manner as the other animals, except they were not irradiated.

The effect of irradiation on the red blood cells is seen in Figure 3. Unfortunately, the mean red blood cell count of the experimental group was somewhat less than that of the control group at the beginning of the study, and thus an actual comparison between the two groups is somewhat weakened. However, it is evident that, proportionately, there were no significant differences between the two groups throughout the experimental period of 72 weeks.

The effect of the irradiation on the total leukocyte count similarly indicates no significant differences between that of the experimental males (Fig. 4) or females (Fig. 5) when compared to control males (Fig. 6) or females (Fig. 7). In general, there is a steady decrease in the total leukocyte count through the experimental period in both the irradiated animals and the control animals; the differences in magnitude, however, are no greater in one group than in the other.

The apparent decrease in the white blood cell count as observed in all groups from the beginning of the study and lasting through about 12 weeks is attributable to the fact that initially ether anesthesia was not used during the removal of the blood samples and the animal was excited. It is a well-accepted fact that under such circumstances the animals will have a pronounced leukocytosis.[6]

These studies, which lasted 72 weeks, would seem to suggest that rather high amounts of irradiation of the head from a dental x-ray unit do not significantly alter the red or white blood cell count. It should be understood clearly, however, that these studies do not eliminate any concern of the dangers of excessive or misused dental roentgen-ray technics. Neither do they throw any light on the enzymatic, biochemical, or genetic changes which may result, even though they have never been shown to occur,

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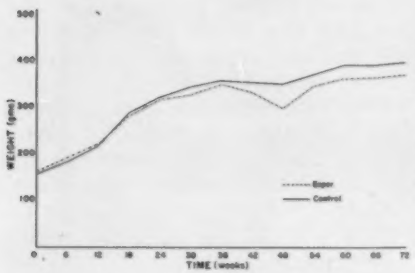


Fig. 2 • Comparison between weight increases in experimental (irradiated) and control rats

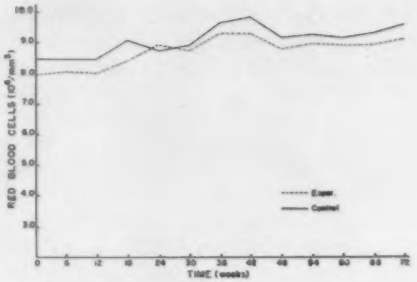


Fig. 3 • Comparison between red blood cell counts in experimental (irradiated) and control rats

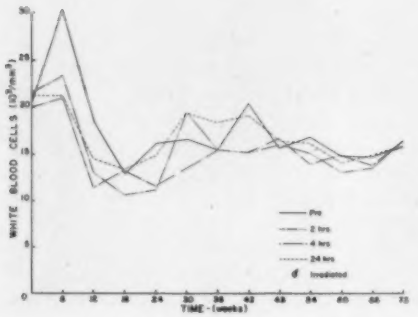


Fig. 4 • Comparison between white blood cell counts at various periods after irradiation in male rats

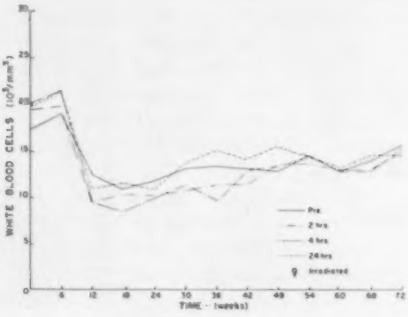


Fig. 5 • Comparison between white blood cell counts at various periods after irradiation in female rats

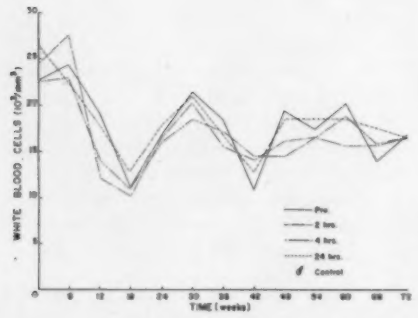


Fig. 6 • Comparison between white blood cell counts at various periods in control male rats

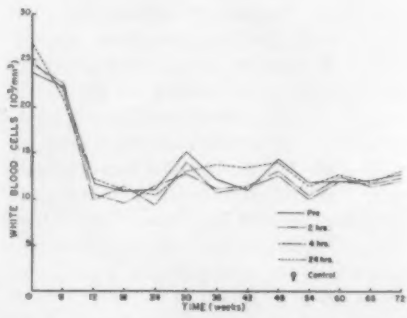


Fig. 7 • Comparison between white blood cell counts at various periods in control female rats

from dental roentgenographic procedures. Such studies are badly needed in dental research, and it is hoped that they will be undertaken.

It seems unscientific to state that no harm will result from dental roentgen-ray procedures simply because no people have died during the past 70 years solely from, or as contributed partially from, diagnostic dental roentgen-ray procedures. Dental research workers should seek the advice of interested geneticists and ask their help and guidance in outlining and carrying out such tests as to define clearly the nature of the harmful effects. However, it seems just as unscientific to translate to the human being the results obtained on whole body irradiation using lower forms of animal or plant life. Much further study is needed in this most interesting area. It is also well to keep in mind that there is probably an important difference between a dentist's use of roentgenology for diagnostic purposes and a physician's use of roentgen rays for both diagnostic and therapeutic purposes.

The studies of Nolan and Patterson,[7] Smith,[8] Hannah and co-workers,[9] Meklas,[10] Goldsmith,[11] Reich,[12] Fowler,[13] and Fixott and others[14] all indicate how the amount of roentgen-ray radiation (roentgens per minute in air) received by the patient and the dentist can be reduced by the addition of a filter, use of long cone and fast film, proper collimation (roentgen-ray beam restricted to precisely the required area by means of a lead diaphragm), and by eliminating tube head leakage.

## CONCLUSIONS

In order to gain more knowledge concerning the effects of roentgen-ray radiation produced by a dental x-ray unit, a study of the total red and white blood cells of rats before and after exposure of the head to roentgen rays was conducted. Each of the experimental rats was exposed to a total dose of 2,016 r during a period of 72 weeks. Red and white blood cell counts, which were measured at each irradiation period, indicated no significant differences between the irradiated group and the control group values.

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*Mystery in Art and Science* • The most beautiful thing we can experience is the mysterious. It is the source of all true art and science. He to whom this emotion is a stranger, who can no longer pause to wonder and stand rapt in awe, is as good as dead: his eyes are closed. . . . To know that what is impenetrable to us really exists, manifesting itself as the highest wisdom and the most radiant beauty only in their most primitive forms—this knowledge, this feeling, is at the center of true religiousness. In this sense, and in this sense only, I belong in the ranks of devoutly religious men. ***Albert Einstein.***

# Permanent tooth mortality: a clinical study of causes of loss

*Harold W. Krogh, D.D.S., Washington, D. C.*

In 1929 Brekhus[1] published his observations based on the extraction of 13,909 teeth from 2,723 patients at the University of Minnesota Dental School clinic. Caries and periodontal disease were responsible for 96.62 per cent of the extractions and the remaining 3.3 per cent were due to impactions, cystic conditions, supernumerary teeth and accidents. Loss due to caries was highest during the growth and developmental periods of the patients, whereas loss due to periodontal disease began after maturity and increased with age, with a corresponding decrease in the loss due to caries.

Allen[2] in 1944 analyzed the causes of extraction of 1,424 teeth from 353 patients at the University of Michigan Dental School clinic. Caries accounted for the loss of 48.8 per cent of the teeth, periodontal disease for 40.7 per cent, and only 2.8 per cent were lost for prosthetic reasons.

The study on which this paper is based was designed primarily to help answer the question of whether periodontal disease or caries is the predominant cause of tooth mortality. Collection of data for this purpose, however, also yielded information on all causes of tooth loss in a well-defined population. The paper, therefore, is concerned with all causes of mortality of teeth encountered in a private oral surgery practice among a middle income group in Washington, D. C., during one calendar year.

## METHOD

A total of 8,420 teeth were removed from 3,037 patients during the year. The same person made a roentgenogram of every tooth preoperatively, determined the specific reason for each extraction, performed the surgery and transferred pertinent data to punch cards. A card was made for each tooth extracted.

The punched cards were first sorted by the age, sex, and economic status of the patients. Cards for the relatively few patients who were designated as being of high or low economic status were eliminated from the study in order to provide a homogeneous population from the standpoint of income and, when either the cause of loss or the specific tooth lost was not indicated, all cards for the patient were omitted from the tabulation of the group selected for study. Thus, the analyses are based on 7,109 permanent teeth extracted from 2,337 patients. There were 744 males with 2,331 extracted permanent teeth, and 1,593 females with 4,778 teeth extracted.

The number of and the reasons for the extractions were determined for each patient, so that statistical tests of validity might be made on the basis of mean

Research Foundation, Doctors Hospital.

1. Brekhus, P. J. Dental disease and its relation to the loss of human teeth. J.A.D.A. 16:2237 Dec. 1929.

2. Allen, E. F. Statistical study of primary causes of extraction. J. D. Res. 23:453 Dec. 1944.

numbers of teeth extracted per patient. These tests were made on the assumption that accuracy and consistency in classifying causes of tooth loss were maintained in the collection of the data and its transfer to punch cards.

The definitions that will be listed were used in the processing of the data by A. L. Russell of the National Institute of Dental Research who designed the study and performed the statistical analyses presented in the tables and in the text, with the exception of those in Table 2.

*Reason for Extraction* • Where two or more "reasons" for extraction were recorded on the punched cards, precedence was assigned as follows:

Orthodontic + unerupted — orthodontic was used.

Pericoronitis + unerupted or partially erupted—pericoronitis was used.

Caries + unerupted or partially erupted —caries was used.

"Acute" and "aching" were always used as adjectives, and cause was allotted to the accompanying reason. "Nonvital" was considered to be a primary cause when no other cause was indicated.

*Statistical Tests* • In the analysis of results of this investigation, statistical tests have been applied to the data. It should be emphasized that statements based on these tests do not necessarily imply that the statements would hold true for the whole population of individuals of middle economic status who are candidates for tooth extraction. The tests merely indicate that, if a large number of samples were drawn from individuals similar to those who comprised the sample under consideration, the statements based on statistical tests would be valid at least 95 times in 100 such samples. If the sample studied can be considered as representative of an entire population of like characteristics and if this population were "rated" by the criteria used for the sample, the statements herein are valid for the population.

Statements of statistical validity in this paper are designated by suffixes (t), (F), (P), or ($X^2$), indicating the type of statistical test which was applied to each.

## ANALYSIS OF DATA

Table 1 indicates that, in all ages combined, relatively twice as many teeth (approximately 40 per cent) were extracted because of dental caries as for periodontal disease or for prosthetic reasons. On a cumulative percentage basis (Table 2), 54.8 per cent of the teeth lost from dental caries were lost by age 40, as compared with 14.7 per cent of those lost from periodontal disease. In the next three decades of life, percentage loss for caries and periodontal disease were nearly equal.

The percentages of teeth lost from dental caries were approximately equal in males and in females (P). Males lost substantially more teeth from periodontal disease than did females (F). As Table 1 indicates, females lost substantially fewer teeth because of periodontal disease than because of caries in all decades except that from 50 to 59 years of age, whereas in males, periodontal disease led caries as a cause of tooth loss in the three decades between 40 and 69 years of age. In the entire group, at ages 70 and over, more teeth were lost from caries than from periodontal disease.

Females lost substantially more teeth for prosthetic reasons than did males (F), and more because of prosthetic reasons than because of periodontal disease (F). Other causes of extraction were approximately the same for both males and females.

One fifth of all teeth extracted were sound teeth which were removed for prosthetic reasons (Table 3). In most instances, the same patient underwent one or more other extractions which were assigned to a specific pathologic

**Table 1** • Causes of permanent tooth loss by decades of age in 2,337 patients of middle income status

| Age group | No. of persons | No. of teeth extracted | Percentages extracted for various reasons by age groups | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Dental caries | Periodontal disease | Prosthetic reasons | Unerupted, partially erupted | Orthodontic or malposed | All other reasons |
| | | | Males | | | | | |
| 0–9 | 5 | 10 | 30.0 | — | — | — | 40.0 | 30.0 |
| 10–19 | 88 | 237 | 29.5 | — | — | 19.8 | 41.4 | 9.3 |
| 20–29 | 171 | 424 | 48.1 | .7 | 16.7 | 20.8 | 7.3 | 6.4 |
| 30–39 | 131 | 339 | 49.9 | 16.5 | 17.4 | 8.0 | 4.1 | 4.1 |
| 40–49 | 134 | 542 | 35.2 | 44.5 | 15.5 | 1.7 | 1.8 | 1.3 |
| 50–59 | 118 | 395 | 37.5 | 38.0 | 15.2 | .8 | 1.5 | 7.0 |
| 60–69 | 63 | 250 | 30.4 | 47.2 | 15.2 | .8 | — | 6.4 |
| 70 and over | 34 | 134 | 41.8 | 22.4 | 29.9 | — | — | 5.9 |
| Total | 744 | 2,331 | 39.3 | 25.7 | 15.1 | 7.6 | 7.0 | 5.3 |
| | | | Females | | | | | |
| 0–9 | 7 | 10 | 60.0 | — | — | — | 40.0 | — |
| 10–19 | 139 | 407 | 36.4 | — | 10.1 | 19.2 | 31.2 | 3.1 |
| 20–29 | 515 | 1,264 | 49.2 | 2.1 | 11.9 | 25.9 | 4.7 | 6.2 |
| 30–39 | 279 | 813 | 40.0 | 15.4 | 27.1 | 10.7 | 3.4 | 3.4 |
| 40–49 | 246 | 921 | 33.9 | 29.1 | 29.0 | 2.6 | 2.6 | 2.8 |
| 50–59 | 215 | 759 | 33.5 | 35.8 | 26.4 | .7 | .4 | 3.2 |
| 60–69 | 121 | 389 | 33.4 | 22.9 | 37.8 | .5 | 1.0 | 4.4 |
| 70 and over | 71 | 215 | 51.2 | 25.6 | 19.5 | .5 | .5 | 2.7 |
| Total | 1,593 | 4,778 | 39.9 | 17.5 | 22.4 | 11.0 | 5.3 | 3.9 |
| | | | Both groups combined | | | | | |
| 0–9 | 12 | 20 | 45.0 | — | — | — | 40.0 | 15.0 |
| 10–19 | 227 | 644 | 33.9 | — | 6.4 | 19.4 | 34.9 | 5.4 |
| 20–29 | 686 | 1,688 | 48.9 | 1.8 | 13.2 | 24.6 | 5.4 | 6.1 |
| 30–39 | 410 | 1,152 | 42.9 | 15.7 | 24.2 | 9.9 | 3.6 | 3.7 |
| 40–49 | 380 | 1,463 | 34.4 | 34.8 | 24.0 | 2.3 | 2.3 | 2.2 |
| 50–59 | 333 | 1,154 | 34.8 | 36.6 | 22.5 | .7 | .8 | 4.6 |
| 60–69 | 184 | 639 | 32.2 | 32.4 | 29.0 | .6 | .6 | 5.2 |
| 70 and over | 105 | 349 | 47.6 | 24.4 | 23.5 | .3 | .3 | 3.9 |
| Total | 2,337 | 7,109 | 39.7 | 20.2 | 20.2 | 9.9 | 5.8 | 4.4 |

cause. When the additional extractions were necessary chiefly because of dental caries, it was assumed that the prosthetic extractions were secondary to dental caries. Similarly, if periodontal disease was the main cause for the additional extractions, the prosthetic extractions were assigned to the periodontal disease category. Most of the remainder, classified as "other and unknown," were removed because of attrition, to facilitate operative procedures, or for radiation of tumors. Thus, as Table 3 shows 1,420 sound teeth or 20 per cent of 7,109 were lost for prosthetic reasons. Since the number of prosthetic extractions per patient did not differ significantly for males and females (4.19 teeth in males and 4.45 in females (t)), the data in Table 3 are shown for the two sexes combined.

At all ages, 53.4 per cent of the prosthetic extractions were secondary to extractions for dental caries; 19.0 per cent to periodontal disease; the remaining 27.6 per cent to other causes.

It might be assumed that the sound teeth would not have been lost had other teeth remained useful and, hence, that the true cause of their loss was the primary accompanying cause. On the basis

**Table 2** • Cumulative percentages of permanent teeth lost for specific reasons; (7,109 teeth in 2,337 patients of middle economic status)

| Age group | No. of teeth extracted | Cumulative percentages of teeth extracted for various reasons | | | | |
|---|---|---|---|---|---|---|
| | | Dental caries | Periodontal disease | Prosthetic reasons | Unerupted, partially erupted | All other reasons |
| Under 10 | 20 | 0.3 | — | — | — | 1.5 |
| Under 20 | 664 | 0.8 | — | 2.9 | 17.8 | 37.2 |
| Under 30 | 2,352 | 37.3 | 2.0 | 18.6 | 77.0 | 63.4 |
| Under 40 | 3,504 | 54.8 | 14.7 | 38.2 | 93.3 | 75.3 |
| Under 50 | 4,967 | 72.6 | 50.2 | 62.9 | 98.1 | 84.4 |
| Under 60 | 6,121 | 86.8 | 79.6 | 81.2 | 99.3 | 92.9 |
| Under 70 | 6,760 | 94.1 | 94.1 | 94.2 | 99.9 | 98.0 |
| 70 and over | 7,109 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

of assigning the teeth lost solely for prosthetic reasons to the accompanying causes, the tooth mortality from dental caries would still be greater than that from periodontal disease in each age group. The percentages for the 7,109 teeth extracted would become 50.38 because of dental caries; 23.99, periodontal disease; and 25.63 for all other reasons.

Data as to the percentages of each type of tooth extracted are presented in Table 4. This table reflects, by the preponderance of third molars, the specialty practice on which the study is based.

Significantly more teeth were lost from caries than from periodontal disease (F) in all types except the central incisor in the maxilla and the central and lateral incisors and the cuspid in the mandible.

Prosthetic reasons accounted for extraction of more maxillary central incisors and of more mandibular cuspids than did periodontal disease (F); they also accounted for the extraction of more maxillary cuspids than either caries or periodontal disease.

Mean ages of patients at the time of tooth loss by type of teeth extracted are shown in Table 5. In both sexes third molars were lost at the earliest age, and the lower anterior teeth (central, lateral and cuspid) were retained longest (t).

On the whole, males retained their teeth about two years longer than did fe-

**Table 3** • Number of sound permanent teeth extracted for prosthetic reasons in 2,337 patients of middle economic status (both sexes), with percentages in which concurrent extractions were due to dental caries, to periodontal disease or to other or unknown causes

| Age group | No. of persons | No. of sound teeth extracted | Percentages in which concurrent extractions were due to various causes | | |
|---|---|---|---|---|---|
| | | | Dental caries | Periodontal disease | Other or unknown |
| 0–9 | 12 | 0 | — | — | — |
| 10–19 | 227 | 41 | 87.80 | — | 12.20 |
| 20–29 | 686 | 222 | 72.52 | 2.70 | 24.78 |
| 30–39 | 410 | 279 | 52.69 | 11.47 | 35.84 |
| 40–49 | 380 | 351 | 48.43 | 27.07 | 24.50 |
| 50–59 | 333 | 260 | 39.62 | 24.23 | 36.15 |
| 60–69 | 184 | 185 | 51.89 | 25.95 | 22.16 |
| 70 and over | 105 | 82 | 54.88 | 31.71 | 13.41 |
| Total | 2,337 | 1,420 | 53.38 | 19.01 | 27.61 |

males (t). This statement is true for maxillary teeth as a group (t); in the mandible, however, females retained the lower anterior teeth about two years longer than did males (t); males retained second and third molars about three years longer than did females (t); and bicuspids and first molars were lost at about the same age in each sex (t).

## COMMENT

As previously stated, the purpose of this paper is to help answer the question of whether periodontal disease or caries is the predominant cause of permanent tooth mortality. It is recognized that the present study, based on experience in a referral practice, cannot safely be projected to represent the tooth mortality experience of the general population. Only as knowledge is accumulated by further studies of segments of the population will a more definite conclusion be possible. For this reason, it is hoped that the present study will stimulate general practitioners, periodontists and others in the dental profession to conduct similar studies. Additional value would accrue from such studies if they were based on geography, race, and economic status of individuals seen in each type of practice.

## SUMMARY

Data were analyzed on causes of mortality of permanent teeth extracted in a private oral surgery practice in Washington, D. C., during a one-year period. A total of 7,109 teeth removed in 744 males and 1,593 females of middle economic status were selected for study.

Approximately 40 per cent of the total tooth loss was caused by dental caries,

**Table 4** • Percentages of permanent teeth, by tooth type, extracted for various reasons in 2,337 persons of middle economic status

| Tooth type | No. of teeth extracted | Percentages of teeth of stated type lost for indicated reason | | | | | |
|---|---|---|---|---|---|---|---|
| | | Dental caries | Periodontal disease | Prosthetic reasons | Unerupted, partially erupted | Orthodontic or malposed | All other reasons |
| Maxillary | | | | | | | |
| Central incisor | 458 | 22.7 | 32.3 | 39.1 | — | .2 | 5.7 |
| Lateral incisor | 450 | 34.4 | 30.2 | 31.3 | — | .7 | 3.4 |
| Cuspid | 516 | 30.8 | 22.7 | 39.9 | 2.3 | 1.2 | 3.1 |
| First bicuspid | 440 | 39.3 | 15.9 | 23.2 | — | 18.2 | 3.4 |
| Second bicuspid | 385 | 42.6 | 19.0 | 27.5 | .5 | 8.6 | 1.8 |
| First molar | 370 | 53.5 | 26.2 | 13.2 | — | 4.3 | 2.8 |
| Second molar | 421 | 43.2 | 24.5 | 22.6 | .2 | 7.1 | 2.4 |
| Third molar | 862 | 46.5 | 5.6 | 5.5 | 20.0 | 9.4 | 13.0 |
| Total | 3,902 | 39.4 | 20.3 | 23.7 | 4.8 | 6.4 | 5.4 |
| Mandibular | | | | | | | |
| Central incisor | 291 | 13.1 | 50.5 | 31.3 | — | 1.0 | 4.1 |
| Lateral incisor | 303 | 20.8 | 45.5 | 29.7 | — | 1.3 | 2.7 |
| Cuspid | 265 | 30.9 | 33.2 | 33.6 | — | .8 | 1.5 |
| First bicuspid | 350 | 40.9 | 16.6 | 20.3 | .3 | 19.4 | 2.5 |
| Second bicuspid | 329 | 52.3 | 17.6 | 18.2 | .9 | 8.5 | 2.5 |
| First molar | 316 | 81.0 | 9.5 | 6.3 | — | .6 | 2.6 |
| Second molar | 384 | 69.0 | 15.4 | 9.9 | .5 | 1.8 | 3.4 |
| Third molar | 969 | 27.8 | 6.6 | 3.7 | 52.4 | 5.2 | 4.3 |
| Total | 3,207 | 40.2 | 20.0 | 15.4 | 16.0 | 5.1 | 3.3 |
| Grand total | 7,109 | 39.7 | 20.2 | 20.0 | 9.9 | 5.8 | 4.4 |

**Table 5** • Average ages of 2,337 patients of middle economic status at time of loss of permanent teeth by morphologic types

| Tooth type | Average age of patient at time of extraction | | |
|---|---|---|---|
| | Males | Females | Both sexes |
| Maxillary third molar | 32.36 | 29.64 | 30.38 |
| Mandibular third molar | 33.81 | 30.58 | 31.55 |
| Mandibular first molar | 35.89 | 35.81 | 35.84 |
| Maxillary first bicuspid | 39.76 | 37.92 | 38.57 |
| Mandibular second molar | 41.39 | 38.12 | 39.14 |
| Maxillary second bicuspid | 41.95 | 39.79 | 40.58 |
| Maxillary second molar | 44.19 | 39.48 | 40.94 |
| Mandibular first bicuspid | 41.03 | 42.16 | 41.77 |
| Maxillary first molar | 44.58 | 41.73 | 42.72 |
| Mandibular second bicuspid | 43.58 | 42.26 | 42.74 |
| Maxillary lateral incisor | 47.25 | 44.30 | 45.28 |
| Maxillary central incisor | 46.44 | 44.98 | 45.44 |
| Maxillary cuspid | 46.93 | 45.24 | 45.83 |
| Mandibular central incisor | 48.23 | 51.13 | 50.03 |
| Mandibular lateral incisor | 49.87 | 51.08 | 50.65 |
| Mandibular cuspid | 49.39 | 52.49 | 51.42 |
| Total maxillary teeth | 41.45 | 39.15 | 40.15 |
| Total mandibular teeth | 41.20 | 39.80 | 40.27 |
| Total teeth | 41.76 | 39.44 | 40.20 |

and 20 per cent by periodontal disease. Prosthetic reasons also accounted for 20 per cent of the teeth lost.

On a cumulative basis, dental caries exceeded periodontal disease as cause of permanent tooth mortality in each decade of life up to ages 60 to 69. However, as might be expected, losses because of dental caries tended to occur at earlier ages than those from periodontal disease.

Males and females lost approximately equal percentages of teeth from dental caries. Males lost substantially more from periodontal disease than did females, and the reverse was true of loss for prosthetic reasons.

At all ages, 53.4 per cent of sound teeth extracted for prosthetic reasons were considered secondary to extractions for dental caries; 19.0 per cent to periodontal disease; and 27.6 per cent to other causes such as attrition, removal to facilitate operative procedures or radiation of tumors.

Caries led periodontal disease as cause of extraction in all except four tooth types, three of these in the mandible. Prosthetic extractions accounted for loss of more maxillary central incisors and of more mandibular cuspids than did periodontal disease, also for loss of more maxillary cuspids than either caries or periodontal disease.

On the whole, males retained their teeth about two years longer than did females, with the exception of the lower anterior teeth in the mandible.

*1835 Eye Street, N.W.*

*Behind Man's Veneer* • Behind his civilized veneer, man harbors in himself an asocial nucleus more destructive than the atomic nucleus which he has recently put into service of his own destructive purposes. *Franz Alexander.*

# The dynamics of dentofacial growth and development relative to space maintenance

*Edward A. Lusterman, D.D.S., Rockville Centre, N. Y.*

It is within the dentist's province to avert, at least in some instances, the malformations of the face and teeth to which children may be subject. To render service with competence, the dentist must fully understand the dynamics of the growing face and dentition; this article will review those growth factors most pertinent to the subject, and touch only briefly on the technics of treatment.

The growth and development of the craniofacial mass involve three important interrelated factors: (1) dimensional increase, brought about by additions of bone along the lines of sutures in all three planes of space; (2) proportional changes, which make possible the proper adjustment of individual parts to the composite; (3) translatory adjustments, effected essentially by the face growing forward and downward, and the cranium upward and backward from the fixed base of the sphenoid bone, to which both the face and the cranium are commonly hafted.

The cranium enlarges by sutural growth. This is the type of growth that takes place in the maxilla. The sutures are parallel to one another, and are so directed that these active growth areas will effect a downward and forward path of all the structures anteriorly placed. Krogman[1] has deduced from Hellman's studies on facial growth that in the first five years of life 78 per cent of vertical height, 82 per cent of depth and 85 per cent of width are achieved. Obviously, such tremendous increment is necessary, in part, to allow for the massing and future eruption of the permanent teeth. As each of the permanent molars then erupts, growth takes place from behind to accommodate it. Inasmuch as each tuberosity is indirectly backed up against the immobile sphenoid, a wedging force is created, effecting a forward translation of the maxillae.

Change in proportion, with concomitant change in form, may be observed by studying growth of the mandible, which consists of surface additions of bone externally and corresponding surface resorptions internally. There is no interstitial bone growth, as Sicher and Weinmann[2] have substantiated.

The growth of the alveolar border, the erupting teeth and condylar growth are responsible for increase in the height of the jaws. The deposition of bone is greater in the incisal region than posteriorly. Increase in length is brought about by depositions on the posterior border of the ramus and condyle and by labial and buccal additions. The propor-

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Attending, chief of orthodontics, Jewish Chronic Disease Hospital, Brooklyn, N. Y.

1. Krogman, Wilton M. Growth theory and orthodontic practice. Angle Orthodont. 10:179 Oct. 1940.

2. Weinmann, J. P., and Sicher, H. Bone and bones; fundamentals of bone biology. St. Louis, C. V. Mosby Co., 1947.

tions of the mandible also increase in width, by additions to the alveolar border and by great increments in the mandibular angles. It is important to note that the hyaline cartilages of the condyles undergo rapid proliferation, so that their subsequent replacement by bone increases the height of the ramus and also adds to the over-all length of the body. The condyles in the young mandible are obliquely adjusted to the body, upward and backward, so that their growth against the fossa will force the body downward and forward. This growth, of course, does not increase the length of the body but merely changes its spatial position. It is Strang's[3] belief (based upon the studies of Brash, Schour and Brodie) that both maxillary and mandibular growth, insofar as the bodies of the bones are concerned, is generally completed by the time of eruption of the first permanent molars and thereafter there is only translatory adjustment.

It is apparent, therefore, that the face and dentition, in the absence of deleterious habits or disturbed health, follow a normal and orderly maturation process in their growth. This has been portrayed roentgenographically in the Bolton study conducted by Broadbent.[4]

This, then, in its simplest sense, is the method by which the normal craniofacial complex develops; but there are gradients of growth which must be considered. The importance of these several gradients will be apparent later when some practical applications in treatment are related to growth and development of the dentition. These five gradients of growth are: time, intensity, age, locus and duration.

The growing dentition housed within the facial mass and, particularly, the import of the relationship of the musculature to those wedging forces which play so great a part in dentition growth, must be understood if a rationale for space maintenance is to be established. Those forces operating within the several components of the dentition, and the muscular forces should be studied.

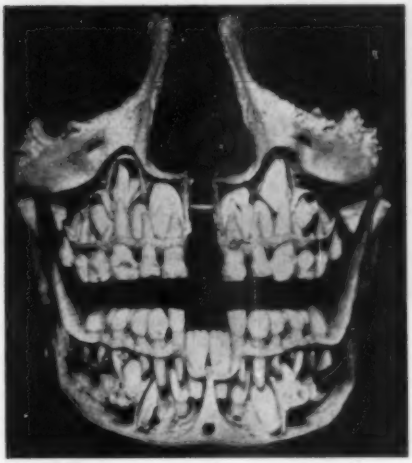

Fig. 1 • Front view of skull. Note relationship of incisors and cuspids to each other, and the roots of deciduous teeth. (Illustration courtesy of Strang)

## THE ANTERIOR SEGMENT

Figure 1 demonstrates the lingual placement of the permanent incisor and canine crypts. With resorption of the deciduous roots between the fifth and seventh years, and concomitant with the lateral growth of the maxillae and mandible at this stage of development, the permanent teeth exert a wedging and widening action as they seek to erupt. However, even prior to the exfoliation of the deciduous anterior teeth there is generally a gradual but very perceptible increase of interdental spacing over a varying period of time. Obviously, this growth spurt allows for the events to follow, and the wider permanent teeth are enabled to erupt into the enlarged area. Figure 2

3. Strang, R. H. W. A text-book of orthodontia. Philadelphia, Lea & Febiger, 1950, p. 238.

4. Broadbent, B. Holly, Ontogenetic development of occlusion. Philadelphia, University of Pennsylvania Press, 1941.

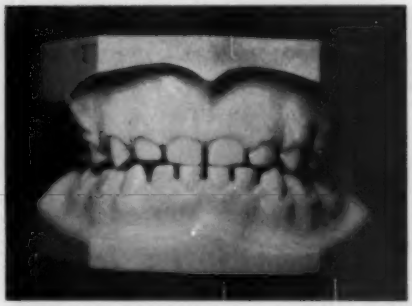

Fig. 2 • Normal deciduous dentition, shown in edge-to-edge bite, demonstrating interdental spacing in anterior segments

shows such a normal deciduous dentition.

These considerations of growth and dentition development can mean that maintenance of space in the anterior segment is not generally necessary in the event of premature loss of deciduous teeth. Sometimes, however, it is, and the decision is usually dictated by either the time and age factors involved or the ectopic and delayed eruption of one or more incisors. If a deciduous incisor has been prematurely lost and observation discloses that there is a tendency toward closure, space should be maintained. The tendency toward closure is greater in the lower arch than the upper; probably in part because this is the contained arch and also because it is more easily affected (because of its lesser bulk) by the outer muscular forces if they are in a state of imbalance. When maintenance is necessary, I have found that in the lower jaw an 0.040 lingual arch is an effective appliance, and for the maxillary arch I frequently employ a simple palate plate, adding the tooth or teeth to be supplied.

Figure 3 illustrates the space closure in the maxillary left incisor region which resulted from the premature loss of the deciduous central incisor and the ectopic and delayed eruption of the homologous permanent incisor. Obviously, had this condition been properly observed and steps taken to prevent it, the orthodontic therapy now required to create room by driving the buccal segment distally would have been unnecessary. Figure 4, on the other hand, shows the casts of a boy, aged 9 years 8 months, who sought professional aid immediately after the loss of the maxillary right central incisor. A Hawley bite plate was used with an acrylic tooth to hold the space for future permanent replacement. Bite opening was effected concomitantly, as can be observed in the casts.

There is no formula, but usually there is little need for anterior space maintenance in the maxillary arch if deciduous teeth have been lost, because the growth gradient and time factors involved are so advantageous at this stage of development. Maintenance may be required more often in the mandibular arch, depending on the stage of development and the estimated potential of the arch to accommodate all the permanent successors. On the other hand, maintenance or replacement is almost always required if one or more permanent teeth have been lost.

### THE POSTERIOR SEGMENTS

Figure 5 is a schematic drawing showing the comparative difference in width between the deciduous cuspids and molars and their homologous successors. There is a leeway space of 1.2 mm. in the maxillary teeth contrasted to 1.7 mm. in the mandibular teeth. This distance, doubled, allows for the movement mesially of the permanent first molars; the movement is greater in the mandibular teeth, and results in the classic interdigitation of the permanent dentition, as contrasted to the edge-to-edge occlusion so often found in normal deciduous dentitions. Figure 6 demonstrates the edge-to-edge occlusion of the completed deciduous dentition, (A); the succeeding transformation after the loss of the deciduous teeth, (D); and the transitional stages in between, (B and C). In the transitional stages, the first

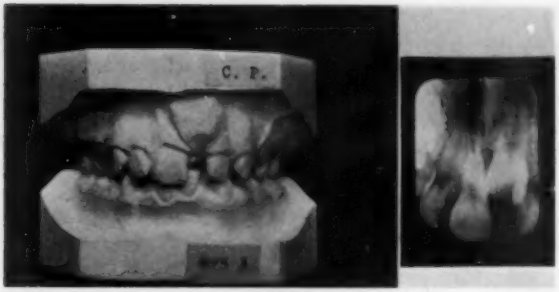


Fig. 3 • Ectopic and delayed eruption of maxillary left central incisor in ten year old patient. Casts and roentgenogram show consequent loss of space, requiring orthodontic therapy

permanent molars have erupted and come into occlusion, and the incisor replacements have erupted. Although much is happening within the dentition at this transitional stage of development, the studies of Hellman[5] and others show that the intensity and duration gradients of growth generally are very low.

It is often stated that it is not usually necessary to maintain space for the prematurely lost first deciduous molar; this is often so, provided that the first permanent molars have come into occlusion. The fact that the molars are locked in occlusion, coupled with the additional support of the second deciduous molars and the low growth gradient, holds the forward movement of the buccal segment to a minimum, so that usually the first bicuspid will be able to erupt uneventfully. This is particularly true when the bone overlying the crypt is thin; in fact, an incision and removal of the little over-

5. Hellman, Milo. Development of face and dentition in its application to orthodontic treatment. Am. J. Orthodont. & Oral Surg. 26:424 May 1940.

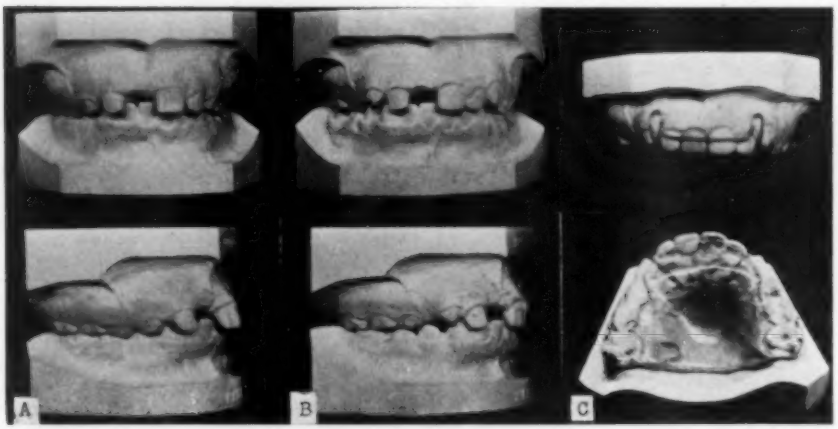


Fig. 4 • Patient, nine years old, with maxillary right central incisor lost through traumatic injury, and with deep overbite (A). Missing tooth replaced and Hawley bite plate inserted, acting as space maintainer. Note closure of spaces, correction of overbite and uprighting of maxillary anterior teeth (B), following which a new appliance was constructed (C), similar to one previously used

lying bone often will hasten the successor's emergence. If, however, the first deciduous molar is lost prior to the eruption of the permanent first molar, maintenance of space may be required because this is generally a period of intensity of growth.

To a lesser degree, space maintenance may not always be required in the event of the premature loss of the second deciduous molar; but here another factor of growth arises which often makes maintenance necessary. If the loss occurs at a period when the second permanent molar is in the process of eruption, there is an active growth locus posterior to the first molar, creating room for both the second and third molars. Thus a wedging force is generated, the intensity of which becomes greater as the second molar continues downward and forward in its eruptive path. Because the direction of growth is also forward and is becoming increasingly intense at this stage of development, it is obvious that a break in the arch could easily result in space closure and consequent impaction of the second bicuspid. Of course, this would not occur in every instance, but in biologic matters variation is to be expected. Time is of importance; frequent examinations are required to avoid similar occurrences in the dynamic, rapidly changing dentition of young patients.

A further wedging force is created by the alveolar growth which occurs coincidental with tooth eruption. As the teeth of the opposite arches meet in occlusion, vertical dental and facial height is increased. Hellman[5] has aptly said this is achieved "by pushing, as it were, the upper and lower face apart."

Space maintainers should be constructed, therefore, not only to prevent loss of space anteroposteriorly, but also to prevent vertical overgrowth of the teeth and supporting structures of the opposing arch. Two types of space maintainers commonly used in my practice are shown in Figure 7. If the first deciduous molar is too unstable to be used as an abutment or has been shed, a removable prosthesis or a lingual arch may be employed, although the latter will lack the advantage of the occlusal bar. In some instances a labial arch, with adjuncts, may be useful, as can be observed in Figure 8.

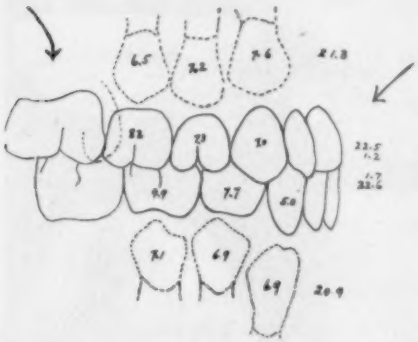

Fig. 5 • Schematic drawing demonstrating difference in width between deciduous cuspids and molars and their homologous successors. Comparison shows that mandibular permanent molar is permitted to move forward to a greater extent than the corresponding maxillary molar during interchange of the dentition

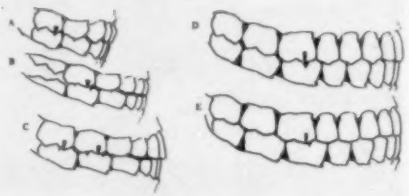

Fig. 6 • Stages of occlusion from three years to old age. A: Edge-to-edge occlusion of completed deciduous dentition in a three year old. B: Patient, age five. The mandibular arch has moved forward with resultant distal relationship of maxillary second deciduous molars. C: Eight year old patient; point of the mesiobuccal cusp of the maxillary molar is slightly mesial to buccal groove of mandibular permanent first molar. D: After interchange of the dentition; molar interdigitation is now correct because of greater differential in size in the mandibular arch of deciduous posterior teeth and their successors. E: Attritional wear of old age, allowing the mandible to slide forward. (Illustration courtesy of Salzmann)

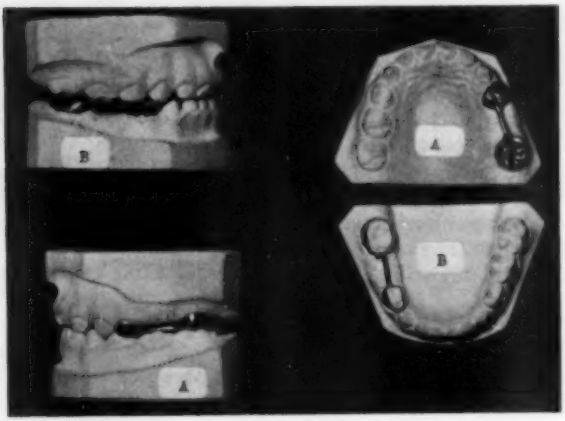


Fig. 7 • Two types of space maintainers. A: Lateral and occlusal views of cast Willett type. B: Lateral and occlusal views of orthodontic band type. Bar is movable in distal lug seat, and maintains occlusal contact

THE CUSPID REGION

The permanent cuspid is formed and erupts late in the dentition development. The changes incidental to the growth and development of the anterior and posterior segments of the arches consequently find the lagging cuspid often subject to the vagaries of aberrant growth patterns. It is apparent that the cuspid may then, so to speak, be caught in a squeeze. Brodie[6] has expressed this as follows:

> Since force travels in a straight line and since the anterior and buccal segments lie in planes that are more or less at right angles to each other, we see that the canine lies at the center of all these forces. That derived from the buccal segment tends to drive this tooth forward in line with the buccal contacts and that from the incisor segment tends to drive it laterally and backward. The resultant of these two is forward and outward, a position in which the canine is frequently found. It is significant that the greatest muscular activity takes place at the corners of the lips, directly over the canine where the muscles of the upper face decussate with those of the lower. The resultant of this activity is inward and backward.

Premature loss of the deciduous cuspid often creates a most vexing problem with respect to space. This tooth is rarely lost because of caries or external trauma; more often than not, occlusal disturbances may cause its early dislodgement. Ectopic eruption of the lateral incisors, growth, or muscular pressures previously referred to, may cause premature resorption. Whatever the cause, it is wise in the event of such loss to look thoroughly into the dentofacial composite to determine whether there seems to be sufficient available bone to accommodate all the permanent teeth. Although I am by no means slavishly devoted to mathematical computations in reaching such a decision, I nonetheless feel that much can be learned by roentgenographic determination of the leeway space, as advocated by Nance[7] and Ballard and Wylie.[8] I have, however, found good lateral jaw plates, taken on 5 by 7 film, better than intra-

6. Gordon, Samuel M. Dental science and dental art. Philadelphia, Lea & Febiger, 1938, p. 197.

7. Nance, H. N. Limitations of orthodontic treatment. Am. J. Orthodont. & Oral Surg. 33:177 April; 253 May 1947.

8. Ballard, M. L., and Wylie, W. L. Mixed dentition case analysis—estimating size of unerupted permanent teeth. Am. J. Orthodont & Oral Surg. 33:754 Nov. 1947.

oral roentgenograms for use as prognostic criteria.

The point which should be stressed is that a decision must be made. Measures can be instituted to take advantage of the leeway space by the use of palate plates or lingual arches; or to hold space by orthodontic means, essentially by the employment of extraoral anchorage and labial arch technic;[9] or, conversely, if the conclusion is that there simply is not enough available bone, the extraction of some permanent teeth and orthodontic intervention must be resorted to. Palate plates, lingual arches, and extraoral therapy are great aids in at least maintaining the status quo; should orthodontic treatment be deemed advisable later, it will be possible to administer it with greater ease, in far less time, and with more salutary results than would otherwise be possible.

When the deciduous cuspids are prematurely lost there are very often other malposed teeth in generally crowded arches. In such instances, orthodontic consultation should be sought early because the problems of anchorage and arch integrity are largely dependent on the maintenance of every bit of available space. Sometimes maintenance would be contraindicated.

## EFFECTS OF MUSCULAR FORCE

The interplay of muscular force on dentition development is not widely understood or appreciated, but is nevertheless a factor of great importance, whether relating to normal development or to the mutilated dentition.

The dental arch is interposed between the powerful tongue muscle on the inner aspect, and the contractile force of the orbicularis oris, buccinator and superior constrictor muscles on the outer side, forming a strong continuous band of tissue anchored to the base of the skull at the pharyngeal tubercle. The latter force is one which, in good tonus, naturally tends to prevent the teeth and their supports from being carried forward in relation to the cranium. Anteriorly, in addition, there is the force of the quadratus labii superior and quadratus labii inferior, the zygomatic, triangularis and caninus muscles, and the platysma myoides. These may be considered as a group as restraining muscles, when properly coordinated. Antagonistic to them, at the posterior ends of the arches, are pressures exerted from the buccinator,

9. Fischer, Bercu. Orthodontics. Philadelphia, W. B. Saunders Co., 1952, p. 107-111.

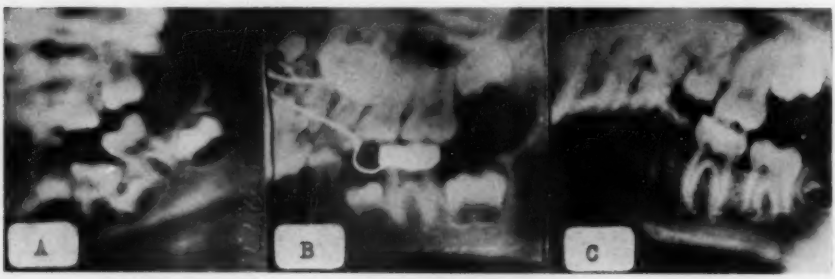


Fig. 8 • Six year old patient with (A) submerged mandibular left second deciduous molar and consequent mesial tipping of the permanent molar. Right side is normal. Note malposition of second bicuspid, aggravating the leaning of the permanent molar. After removal of second deciduous molar (B), labial arch with swivel tubes and other auxiliaries serves as space maintainer while uprighting the permanent molar. Second bicuspid at a later date (C), erupted and in good position but requiring rotation

masseter, temporalis and internal pterygoid muscles, which brace and prevent displacement of the arch ends. No muscle functions singly; muscles act synergistically when they function properly. An upset in balance must produce untoward development of the dentition. Energetic, persistent finger-sucking is a combination of unbalanced oral and extraoral muscular forces. Perverted swallowing habits, usually accompanied by the unruly tongue thrust on the inner side, as well as other deleterious habits, may cause all sorts of aberrations of the muscle pattern, affecting the dentition on both inner and outer aspects. In the absence of such adverse forces, a neuromuscular pattern arising from the proprioceptive system will be established to preserve arch integrity.

Muscular pressures, normally developed, affect the dentition relative to the components of force generated by them. There are two distinct components. One, called the anterior component of force, is generated by the muscles at the posterior arch ends and maintains contacts through the forward movement of the molar mass, with the bicuspids acting as passive transmitters of that force. The other is a distal and lingual component, exerted through the actions of the re-

Fig. 9 • Tendencies in tooth shifting mainly dictated by muscular forces. (Illustration courtesy of Salzmann)

straining muscle forces previously discussed. Other things being equal, it is apparent that so long as there is an equilibrium in these dissimilar forces, normal occlusion should result. Figure 9 demonstrates the tendencies in tooth shifting which are largely dictated by muscular force. If the balance of forces is upset and arch integrity is disturbed by the premature loss of deciduous teeth and lack of maintenance, the consequent imbalance may result in improper development and tooth shifting, leading to malocclusion.

Consideration must be given to whether a normal or an abnormal muscular pat-

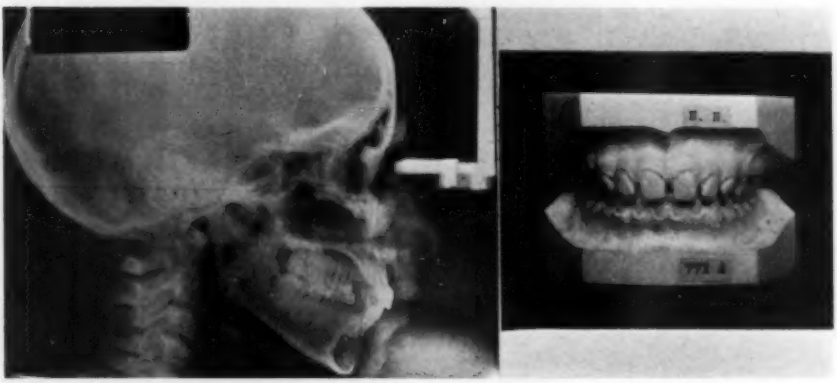

Fig. 10 • Perverted swallowing habit, with tongue thrust, in 12 year old patient. Note effect on teeth and bone, evidenced by bimaxillary protrusion and spacing of teeth

tern is present. Disturbed muscle patterns may evolve either through habits, as previously mentioned, or there may be hypertonic or hypotonic patterns morphogenetic in origin. The diastemata evident in the casts shown in Figure 10 and the bimaxillary protrusion shown in the cephalogram were found in a child with perverted swallowing habits and a tongue thrust. On the other hand, the natural and inherent hypertonicity of the facial musculature, evident in the cephalogram in Figure 11, shows its effect in the crowded dentition, as evidenced by the casts. In a case of this type, with premature deciduous tooth loss due to the insufficiency of bone to accommodate all the teeth in the arches (as well as the hypertoned musculature), orthodontic intervention is required. In the former case, which is illustrated in Figure 10, where the bone mass was more than adequate (as evidenced by the interdental spacing throughout) space maintenance in the event of premature deciduous tooth loss would probably not be required. In such instances, habit correction and orthodontic therapy should be paramount considerations.

There may be many variants from a normal pattern, so every case must be judged as a distinct entity. All factors must be weighed and thoroughly analyzed in order to avoid making haphazard, unwarranted and sometimes even harmful decisions.

## TECHNICAL CONSIDERATIONS

This article does not treat at length of the technic for making appliances to maintain space, or of the care of such appliances. The literature abounds with such information;[10-13] I have found the work of R. C. Willett sound and practical, and recommend a paper correlating his technics with the principles of growth and development.[14]

## CONCLUSION

There is no hard and fast rule for the use of space maintainers. Their use must be based upon a sound knowledge of

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Fig. 11 • Small boned nine year old patient with crowded dental arches and hypertonic facial musculature. Orthodontic intervention, rather than space maintenance, is required in the event of premature loss of deciduous teeth

growth and development and a sense of timing born of experience. It is most important to remember that the dentist cannot place a space maintainer or other appliance and dismiss the patient without further thought. Recementation and periodic check observations with roentgenograms are an absolute necessity and, obviously, removal of appliances is indicated when their usefulness has been outlived. Certainly, frequent observation of the growing dentition is required whether or not space maintainers have been employed.

It may not always be easy to make a decision, and sometimes the dentist learns much from controlled and watchful waiting. But he should derive a great deal of satisfaction from the very real preventive service he is privileged to render.

*165 North Village Avenue*

# The effect of foodstuffs on the pH of dental cavities

*Robert C. Caldwell,* H.D.D., L.D.S., D.M.D., M.S., Birmingham, Ala., and Basil G. Bibby,† D.M.D., Ph.D., Rochester, N. Y.*

Although several studies[1-3] have indicated possible differences in the capacity of various carbohydrate foods to initiate dental caries, no investigation seems to have been directed toward showing whether there are like variations in the activity of different foods in expanding established cavities. The most closely related studies are those of Stephan,[4,5] Fosdick and Burrill,[6] and Box,[7] who showed that a sugar rinse depressed the pH of carious material in dental cavities in the same way that it did the pH of plaque material. A fall from an average pH of 5.5 to an average pH of 4.7 in 2 to 60 minutes was reported by Stephan.[4] More recently Sullivan, Charlton and Lennon[8] have reported a depression of pH of cavities after rinsing the mouth with an acidulated beverage. None of these studies has attempted to differentiate between the effects of different foodstuffs on cavity acidity.

This article reports some comparisons of the effects on the acidity of carious

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*Assistant professor of dentistry, School of Dentistry, University of Alabama.

†Director, Eastman Dental Dispensary.

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4. Stephan, R. M. Changes in hydrogen-ion concentration on tooth surfaces and in carious lesions. J.A.D.A. 27:718 May 1940.

5. Stephan, R. M. The pH of carious lesions. J.D. Res. 24:202 June-Aug. 1945.

6. Fosdick, L. S., and Burrill, D. Y. The effect of pure sugar solutions on the hydrogen ion concentration of carious lesions. Fort. Rev. Chicago D. Soc. 6:7 Dec. 1943.

7. Box, H. K. Hydrogen ion concentration of carious dentine. Oral Health 29:363 May 1939.

8. Sullivan, H. R.; Charlton, G., and Lennon, D. Studies of the hydrogen ion concentration in the mouth. II. Effects of rinsing and of beverages on hydrogen ion concentration. Austral. D.J. 2:42 Feb. 1957.

material *in situ* of a glucose rinse and of selected foodstuffs on which comparisons of acid formation in dental plaques had previously been made.[9] In an attempt to explain unexpected findings, observations are also made on the properties of the test foods and the neutralization of cavity acids.

## EXPERIMENTS

*Measurement of pH in Dental Cavities* • An antimony micro electrode with a fine point 1.5 mm. diameter was used to make measurements of the pH of carious material in dental cavities. This electrode was made, with the aid of Dr. R. B. Nevin of the University of Otago, New Zealand, by sucking molten antimony into thick walled capillary glass tubing which was then drawn to the desired fineness in a flame. The electrode gave readings 0.1 to 0.2 pH units higher than a glass electrode throughout the range of pH 4 to 7.5, when tested in saliva-sugar mixtures. Throughout the study the system was standardized with a pH 5.5 buffer before making each pH measurement.

For testing purposes, only small cavities were chosen in the teeth of subjects 8 to 18 years of age. These cavities were just large enough to allow the tip of the electrode to enter and to rest on the carious material. The subjects were classified according to the caries present in the mouth as + + for average caries activity and +++ for rampant caries. Tests were scheduled so that between one and two hours elapsed between eating and the beginning of the test period.

To establish control values for the pH of each cavity, three separate readings were made immediately before any of the test foods were used. If these control values did not vary by more than 0.1 pH unit, testing commenced.

In the first tests, the subjects rinsed their mouths with 25 ml. of a 10 per cent glucose solution for one minute, and pH measurements were made at intervals, of 2, 5, 10, 15, 20, 30, 40 and 50 minutes. When foodstuffs were tested, an ample portion was consumed by the subject and pH measurements were made at the same intervals as for the glucose solution, but ending after 30 minutes. The foods used were commercial products previously used in tests of changes in plaque pH.[9] They were an oil sprayed cracker, a fig sandwich cookie, a chocolate coated coconut bar, ice cream and a carbonated cola beverage. The cola beverage was drunk from a paper cup rather than by straw or directly from the bottle.

## FINDINGS

The "resting" or control pH values for the cavities are recorded in Tables 1-6. The pH range was 4.6 to 7.1, with most cavities falling in the range of pH 5 to 6. For purposes of comparing these control values with those of other researchers, they were averaged without conversion to hydrogen ion values, resulting in an average of pH 5.5 (s.d. 0.5), which is the same as Stephan's figure.[4]

It appeared at first that the usual cavity pH of the subjects with rampant caries (+++) was lower than that of the average caries group (++). This could be deduced from Table 1. However, when all the control values in Tables 2 to 6 were evaluated, it became apparent that no direct correlation existed between cavity pH and the amount of caries present in the mouth.

*Effect of a 10 Per Cent Glucose Rinse on Cavity pH* • The effect of the glucose rinse is shown in Table 1. A drop in pH was noted in two minutes in many cavities and it occurred within ten minutes in almost all the cavities. The drop in

9. Ludwig, T. G., and Bibby, B. G. Acid production from different carbohydrate foods in plaque and saliva. J.D. Res. 36:56 Feb. 1957.

**Table 1** • Effect of rinsing with 10 per cent glucose for one minute on pH of dental cavities

| Caries present | Cavity site | Control pH | pH Minutes after glucose rinse | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 5 | 10 | 15 | 20 | 30 | 40 | 50 |
| +++ | $\underline{4}$,O | 4.6 | 4.6 | 4.4 | 4.8 | 4.6 | 4.6 | 4.6 | 4.7 | 4.6 |
| +++ | $\underline{6}$,O | 4.8 | 4.8 | 4.7 | 4.6 | 4.6 | 4.5 | 4.5 | 4.6 | 4.7 |
| +++ | $\overline{3}$,Lab | 5.1 | 4.8 | 5.0 | 5.1 | 5.0 | 5.2 | 5.2 | 5.2 | 5.2 |
| ++ | $\overline{6}$,O | 5.2 | 4.9 | 4.8 | 5.0 | 5.2 | 5.2 | 5.3 | 5.4 | 5.5 |
| +++ | $\overline{7}$,O | 5.2 | 5.1 | 5.2 | 5.2 | 5.2 | 5.4 | 4.9 | 5.2 | 4.8 |
| ++ | $\overline{6}$,O | 5.2 | 5.0 | 5.0 | 4.9 | 4.8 | 5.0 | 5.1 | 5.1 | 5.2 |
| +++ | $\overline{7}$,O | 5.2 | 5.1 | 4.9 | 5.0 | 4.9 | 5.1 | 5.3 | 5.4 | 5.2 |
| +++ | $\overline{4}$,O | 5.2 | 5.2 | 5.2 | 4.8 | 4.7 | 4.7 | 4.8 | 4.8 | 5.2 |
| ++ | $\underline{E}$,O | 5.2 | 5.0 | 4.9 | 5.0 | 5.2 | 5.5 | 5.6 | 5.5 | 5.5 |
| +++ | $\overline{7}$,O | 5.2 | 5.0 | 5.0 | 4.8 | 4.7 | 4.9 | 4.9 | 4.9 | 5.0 |
| +++ | $\underline{7}$,B | 5.2 | 5.5 | 5.6 | 5.6 | 5.6 | 5.1 | 5.0 | 5.0 | 5.3 |
| ++ | $\underline{7}$,B | 5.3 | 5.0 | 4.9 | 4.9 | 5.1 | 5.1 | 5.3 | 5.3 | 5.4 |
| ++ | $\underline{6}$,B | 5.4 | 5.3 | 5.3 | 5.5 | 5.5 | 5.7 | 5.7 | 5.7 | 5.8 |
| ++ | $\underline{6}$,O | 5.4 | 5.4 | 5.4 | 5.3 | 5.2 | 5.3 | 5.4 | 5.4 | 5.4 |
| ++ | $\underline{6}$,B | 5.5 | 5.1 | 5.2 | 5.5 | 5.1 | 5.3 | 5.5 | 6.2 | 5.8 |
| ++ | $\underline{E}$,O | 5.5 | 5.3 | 5.1 | 5.0 | 5.2 | 5.3 | 5.3 | 5.3 | 5.6 |
| ++ | $\overline{D}$,O | 5.5 | 5.2 | 5.2 | 5.1 | 5.1 | 5.4 | 5.5 | 5.6 | 5.6 |
| ++ | $\overline{7}$,O | 5.5 | 5.1 | 5.2 | 5.3 | 5.3 | 5.3 | 5.2 | 5.3 | 5.4 |
| ++ | $\underline{E}$,O | 5.6 | 5.2 | 4.6 | 4.7 | 5.2 | 5.3 | 5.4 | 5.8 | 6.2 |
| ++ | $\overline{E}$,O | 5.6 | 5.1 | 4.7 | 4.7 | 4.8 | 5.1 | 5.2 | 5.4 | 5.5 |
| ++ | $\underline{6}$,B | 5.6 | 5.5 | 5.3 | 5.0 | 5.3 | 5.4 | 5.4 | 5.6 | 5.6 |
| ++ | $\underline{7}$,M | 5.6 | 5.4 | 5.2 | 5.0 | 5.2 | 5.3 | 5.4 | 5.6 | 5.6 |
| ++ | $\overline{7}$,B | 5.6 | 5.0 | 5.0 | 4.8 | 4.6 | 4.7 | 4.7 | 5.1 | 5.4 |
| ++ | $\overline{6}$,O | 5.7 | 5.3 | 5.2 | 4.9 | 5.2 | 5.3 | 5.2 | 5.6 | 5.6 |
| ++ | $\underline{E}$,O | 5.8 | 5.6 | 5.5 | 5.1 | 5.0 | 5.4 | 5.4 | 5.6 | 5.8 |
| ++ | $\overline{6}$,O | 5.9 | 5.6 | 5.2 | 4.9 | 5.1 | 5.1 | 5.3 | 5.5 | 5.5 |
| ++ | $\overline{C}$,M | 6.0 | 5.4 | 5.1 | 5.6 | 5.7 | 5.9 | 5.9 | 6.0 | 6.0 |
| ++ | $\underline{6}$,O | 6.0 | 5.5 | 5.2 | 5.2 | 5.5 | 5.6 | 6.0 | 6.0 | 6.0 |

Caries present: ++ average caries; +++ rampant caries.

**Table 2** • The effect of cracker on cavity pH

| Caries present | Cavity site | Control pH | pH Minutes after eating | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 5 | 10 | 15 | 20 | 25 | 30 |
| ++ | $\overline{6}$,O | 4.6 | 6.2 | 6.1 | 5.7 | 5.4 | 5.4 | 5.0 | 4.7 |
| +++ | $\overline{7}$,O | 4.6 | 5.3 | 5.3 | 5.0 | 4.7 | 4.7 | 4.7 | 4.7 |
| ++ | $\underline{6}$,O | 4.9 | 5.4 | 5.3 | 5.4 | 5.5 | 5.2 | 5.4 | 5.3 |
| ++ | $\underline{6}$,B | 5.0 | 5.6 | 5.4 | 5.2 | 5.1 | 5.1 | 5.1 | 4.9 |
| ++ | $\overline{5}$,O | 5.1 | 5.5 | 5.7 | 5.3 | 4.9 | 5.0 | 5.1 | 5.0 |
| ++ | $\underline{7}$,O | 5.1 | 5.4 | 5.3 | 5.1 | 5.2 | 5.2 | 5.1 | 5.2 |
| ++ | $\underline{6}$,O | 5.4 | 5.4 | 5.6 | 5.4 | 4.9 | 4.8 | 4.7 | 4.7 |
| ++ | $\underline{7}$,O | 5.6 | 6.7 | 6.1 | 5.6 | 6.6 | 6.0 | 5.7 | 6.0 |
| +++ | $\underline{5}$,O | 5.6 | 6.3 | 6.5 | 6.2 | 5.8 | 5.5 | 5.7 | 5.8 |
| ++ | $\underline{5}$,B | 5.7 | 6.2 | 5.9 | 5.7 | 5.6 | 5.6 | 5.6 | 5.5 |

Caries present: ++ average caries; +++ rampant caries.

pH was from 0.1 to 1.0 pH units and thereafter the cavity pH began to return to the control value. By the end of the 50 minute test period, the pH of practically all the cavities had returned to the original level.

*Effect of Foods on Cavity pH* • The effects of the test foods are listed in Tables 2 to 6. Instead of producing a fall in pH, as the glucose rinse had, the foods generally caused a pH rise. This initial swing toward neutrality was followed by a return toward the control value and often a subsequent depression in pH. However, only occasionally was there any appreciable drop below the "resting" or control value of the cavity. The lowest pH values were reached later than had been the case following the glucose rinse, and the return to the "resting" value was correspondingly delayed.

The solid foods caused an average rise of 0.6 in cavity pH. In one instance after cracker had been eaten (Table 2), the cavity pH rose from 4.6 to 6.2. The swing toward neutrality was not so pronounced with the cola beverage, but even with that acidic beverage (pH 2.5) only four of 70 readings fell below pH 5.0, and these were in cavities in which the initial pH was between 5.1 and 5.3.

*Buffer Properties of the Test Foods* • The rise in cavity pH after the test foods were eaten could have been the result of buffering effects of the foods. Accordingly, pH measurements were made of the test foods, and their acid or alkaline buffering capacity determined.

The pH of 2 per cent aqueous solutions or suspensions of the cracker, fig cookie, candy bar and ice cream was found to be higher than the pH of the average cavity. A 2 per cent aqueous solution of the cola beverage (pH 4.05) had a pH lower than that of the average cavity. Undiluted cola had a pH of 2.5. These findings are reported in Table 7, together with the milliliters of 0.1 normal hydrochloric acid required to change the pH of 150 ml. aliquots of 2 per cent aqueous solutions or suspensions of each foodstuff from pH 6.5 to 4.5 in intervals of 0.5 pH units. For titrating the cola beverage in the reverse direction, the values are for 0.1 normal sodium hydroxide. The food mixtures were titrated from pH 3 to pH 10.

Table 7 shows that the solid foods had buffer properties considerably greater at these dilutions than did the cola beverage or 10 per cent glucose; and they probably had a buffering effect on the carious material, accounting for the results shown in Tables 1 to 6. If the cola beverage was

**Table 3** • The effect of fig cookie on cavity pH

| Caries present | Cavity site | Control pH | pH Minutes after eating | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 5 | 10 | 15 | 20 | 25 | 30 |
| +++ | $\underline{6}$,0 | 4.6 | 5.0 | 4.9 | 4.6 | 4.8 | 4.5 | 4.6 | 4.6 |
| ++ | $\underline{5}$,MO | 4.7 | 5.2 | 5.5 | 5.2 | 5.1 | 4.9 | 4.9 | 4.6 |
| ++ | $\overline{5}$,DO | 5.3 | 5.4 | 5.6 | 5.7 | 5.4 | 5.0 | 5.4 | 5.3 |
| ++ | $\overline{7}$,0 | 5.4 | 6.3 | 6.1 | 6.0 | 6.0 | 5.6 | 5.6 | 5.3 |
| ++ | $\underline{4}$,DO | 5.6 | 5.6 | 5.8 | 6.0 | 5.8 | 5.7 | 5.7 | 5.6 |
| +++ | $\underline{5}$,0 | 5.8 | 6.8 | 6.6 | 6.4 | 5.4 | 5.6 | 5.3 | 5.2 |
| ++ | $\overline{5}$,B | 5.8 | 5.7 | 6.1 | 6.1 | 5.9 | 6.2 | 5.9 | 5.9 |
| ++ | $\overline{7}$,0 | 6.2 | 6.9 | 6.9 | 6.6 | 6.5 | 6.4 | 6.1 | 6.1 |
| ++ | $\overline{7}$,B | 6.2 | 7.2 | 6.6 | 6.5 | 6.4 | 6.6 | 6.5 | 6.4 |
| ++ | $\underline{5}$,M | 6.4 | 6.3 | 6.4 | 6.3 | 6.3 | 6.3 | 6.3 | 6.2 |

Caries present: ++ average caries; +++ rampant caries.

titrated in undiluted form it still had less buffer capacity than the foods.

*Persistence of Acidity of Cavities* • It was apparent from pH measurements of resting cavities that, unlike bacterial plaques on the tooth surface, their acidity persists for many hours after eating. It could be assumed that there is some sort of acid reservoir in some cavities which causes them to be so acid. To investigate this point, tests were made on six subjects who had not eaten for at least 12 hours. Cavities were isolated from saliva by cotton rolls and a saliva ejector, and control pH measurements were made. Immediately thereafter, 0.1 molar phosphate buffer of pH 6.8 was added to the cavity until it was filled. The cavity was dried with a cotton pledget after about one minute, and pH readings were taken again. Buffer was added repeatedly until the pH of the cavity rose no further. The cavity was then dried carefully and pH readings taken at intervals of 2, 5, 10 and 20 minutes, unless the reading returned to the control value. At all times, the cavity was isolated from saliva and other extraneous materials except the buffer and cotton pledgets. In some instances these procedures were repeated three times during one visit, as shown in Table 8.

The results of buffering were variable and seemed to fall into two groups. Three cavities (1, 2 and 3—Table 8) resisted repeated attempts to maintain them at a higher pH than their control pH. It seems that in these cavities sufficient acid was present to overcome large amounts of buffer.

Three other cavities (4, 5 and 6—Table 8) were easily buffered, but the addition of one drop of 10 per cent glucose at the end of the test period caused the pH of the cavities to drop almost immediately.

## DISCUSSION

Our findings are in agreement with those of Stephan,[4] both in respect to the average pH (5.5) of carious material *in situ*, and the effect of a glucose rinse on the acid content of cavities.

However, our findings with the carbohydrate-containing foodstuffs differ from what was found with the glucose rinse. The foods generally effected a transient rise of cavity pH, and the limited acid formation which followed occurred much more slowly than after a glucose rinse.

**Table 4** • The effect of ice cream on cavity pH

| Caries present | Cavity site | Control pH | pH Minutes after eating | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 5 | 10 | 15 | 20 | 25 | 30 |
| ++ | $\lfloor \underline{6}$,O | 4.7 | 5.5 | 4.5 | 5.0 | 4.8 | 4.8 | 5.3 | 5.2 |
| +++ | $\lfloor \underline{1}$,M | 5.1 | 5.4 | 5.3 | 5.3 | 5.1 | 5.1 | 5.3 | 5.7 |
| ++ | $\lfloor \underline{6}$,O | 5.1 | 5.0 | 4.8 | 4.9 | 5.1 | 5.0 | 5.1 | 5.1 |
| +++ | $\lfloor \underline{5}$,O | 5.5 | 6.4 | 5.8 | 5.8 | 5.8 | 5.5 | 5.5 | 5.5 |
| ++ | $\lceil \underline{6}$,O | 5.7 | 5.6 | 5.6 | 5.6 | 6.1 | 5.7 | 5.6 | 5.6 |
| ++ | $\lceil \underline{7}$,O | 5.8 | 6.0 | 6.4 | 5.8 | 5.5 | 5.5 | 5.5 | 5.8 |
| ++ | $\lceil \underline{5}$,B | 6.0 | 6.0 | 6.0 | 5.8 | 6.0 | 6.0 | 6.1 | 6.0 |
| ++ | $\underline{5}$],MO | 6.1 | 6.6 | 6.4 | 5.9 | 5.9 | 5.9 | 5.7 | 5.7 |
| ++ | $\overline{5}$],MO | 6.5 | 6.7 | 6.4 | 6.4 | 6.4 | 6.7 | 6.5 | 6.6 |
| +++ | $\lceil \underline{2}$,M* | 7.1 | 7.0 | 7.3 | 6.9 | 6.6 | 6.7 | 6.9 | 7.2 |

Caries present: ++ average caries; +++ rampant caries.
*Large cavity.

**Table 5** • The effect of candy bar on cavity pH

| Caries present | Cavity site | Control pH | pH Minutes after eating | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 5 | 10 | 15 | 20 | 25 | 30 |
| ++ | $\overline{6}\lfloor$,O | 4.9 | 6.2 | 5.9 | 5.7 | 5.3 | 5.1 | 5.1 | 5.0 |
| ++ | $\lfloor\underline{6}$,O | 4.9 | 5.3 | 5.3 | 5.3 | 5.5 | 5.0 | 4.7 | 4.5 |
| ++ | $\lfloor\underline{6}$,O | 5.1 | 5.7 | 6.6 | 6.1 | 5.6 | 5.1 | 5.2 | 5.1 |
| ++ | $\overline{6}\rceil$,O | 5.3 | 5.9 | 6.3 | 6.4 | 6.4 | 5.8 | 5.8 | 5.7 |
| ++ | $\overline{5}\rceil$,B | 5.6 | 6.2 | 6.4 | 6.0 | 6.1 | 6.0 | 5.3 | 5.3 |
| +++ | $\lfloor\underline{1}$,M | 5.7 | 5.7 | 5.5 | 5.3 | 5.2 | 5.3 | 5.1 | 5.1 |
| ++ | $\overline{7}\rceil$,O | 5.8 | 6.3 | 6.6 | 6.5 | 6.2 | 6.2 | 6.1 | 6.0 |
| +++ | $\lfloor\underline{5}$,O | 5.8 | 6.6 | 6.6 | 6.0 | 5.4 | 5.4 | 5.2 | 5.4 |
| ++ | $\overline{E}\rceil$,O | 6.3 | 6.7 | 6.8 | 6.9 | 7.0 | 6.8 | 6.9 | 6.9 |
| +++ | $\overline{2}\rceil$,M* | 6.6 | 6.6 | 7.2 | 7.0 | 6.5 | 6.5 | 6.3 | 7.2 |

Caries present: ++ average caries; +++ rampant caries.
*Large cavity.

**Table 6** • The effect of cola beverage on cavity pH

| Caries present | Cavity site | Control pH | pH Minutes after drinking | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2 | 5 | 10 | 15 | 20 | 25 | 30 |
| ++ | $\lfloor\underline{6}$,O | 5.1 | 5.6 | 5.5 | 5.5 | 5.4 | 4.8 | 5.2 | 5.2 |
| ++ | $\overline{6}\rceil$,O | 5.1 | 5.8 | 5.4 | 5.2 | 4.9 | 5.4 | 5.2 | 5.2 |
| ++ | $\lfloor\underline{6}$,O | 5.2 | 5.8 | 6.0 | 5.8 | 5.9 | 5.8 | 5.8 | 5.8 |
| ++ | $\overline{6}\rceil$,O | 5.3 | 5.2 | 5.2 | 4.8 | 5.3 | 4.9 | 5.0 | 5.2 |
| +++ | $\lfloor\underline{1}$,M | 5.7 | 5.8 | 5.2 | 5.1 | 5.1 | 5.3 | 5.4 | 5.4 |
| ++ | $\overline{7}\rceil$,O | 5.8 | 5.9 | 6.2 | 6.3 | 6.0 | 6.1 | 6.2 | 6.1 |
| +++ | $\lfloor\underline{5}$,O | 6.0 | 5.8 | 5.7 | 5.3 | 5.4 | 5.4 | 5.6 | 6.0 |
| ++ | $\overline{5}\rceil$,O | 6.3 | 5.9 | 6.3 | 5.9 | 6.0 | 6.1 | 6.3 | 6.2 |
| ++ | $\overline{E}\rceil$,O | 6.3 | 5.7 | 6.1 | 6.5 | 6.2 | 6.2 | 6.5 | 6.6 |
| +++ | $\overline{2}\rceil$,M* | 6.7 | 6.5 | 6.8 | 6.7 | 6.5 | 6.7 | 6.4 | 6.6 |

Caries present: ++ average caries; +++ rampant caries.
*Large cavity.

This observation leads us to suggest that reservations should be held regarding the significance of a glucose rinse as a testing procedure; in the normal course of events, the effects of foodstuffs on cavity and mouth pH would be more pertinent. Also, the report by Sullivan[8] that an acidulated beverage will depress cavity pH should be evaluated with the understanding that rinsing the mouth vigorously for 30 seconds is not the normal method of consuming a beverage.

The rise in pH of dental cavities after ingestion of the cracker, fig cookie, candy bar and ice cream, is probably because these foods have a higher pH than most cavities and have considerable buffering capacity even in 2 per cent aqueous suspensions. The finding of an occasional pH rise in cavities after the ingestion of a cola beverage is more difficult to explain and certainly needs to be confirmed. The only suggestion which can be offered at this time is that because of the location

or the morphology of the cavities, the beverage did not come into direct contact with them, but saliva stimulated by the beverage did have access, and partially buffered the carious material. The fact that some cavities were artificially buffered successfully but became more acid after the addition of a drop of 10 per cent glucose solution, shows the importance of the degree to which the carbohydrate foods gain access to the cavity during ingestion.

An interesting observation is that acid formation is slower after the ingestion of foods than it is after a glucose rinse. This was true in previous studies of acid formation in plaques,[9] as well as in the cavity measurements recorded here. In view of this difference, our results might have had more significance if the readings had been continued over a longer period of time, and had been able to reveal the length of time over which the foods influence cavity acidity.

The finding of an acid condition in practically all cavities, even when no food had been eaten for many hours, raises the question of whether food supplies the only substrate from which cavity acid is formed. Possibly the acid neutralizing effect of the saliva is not great in certain cavities, but in some instances we had difficulty in neutralizing cavity acids. In such instances it is questionable practice to assume that the continuation of the acid reaction is a result of the absence of salivary neutralization. The readiness with which these cavities revert to an acid condition even after repeated buffering seems to show that either the cavity acid is continuously formed or that there is a large reservoir of acid in the depth of the cavity, which continually diffuses to the surface of the carious material. An extended study of the ability of cavities to withstand acid neutralization in relation to their content of decalcified dentin might cast light on this point, as might a history of the cavity in respect to whether the caries is in an inactive or an active state. Such preliminary correlations as we could make did not indicate such relationships.

**Table 7** • The ability of test foods to resist pH change

| Test foodstuff | Initial pH of 2% mixture* | Ml. of 0.1 N.HCl required to change pH from 6.5 to 4.5† |
|---|---|---|
| Cracker | 7.8 | 1.55 |
| Fig cookie | 7.05 | 1.35 |
| Candy bar | 6.75 | 1.75 |
| Ice cream | 7.25 | 1.65 |
| Cola beverage | 4.05 | 0.60‡ |
| 10% glucose§ | 5.9§ | 0.15 |

*150 ml. aliquots of 2 per cent aqueous solution or suspension.
†Values derived from buffer curves from pH 3.0-10.
‡Milliliters of 0.1 N. sodium hydroxide.
§The 10 per cent glucose was not further diluted.

It is quite obvious from the variability of the results we obtained from resting and experimentally observed cavities that there are broad variabilities in cavity acidity. Of course, in view of variations in cavity morphology and location, this could be expected; but here again we were unable to observe any obvious relationships.

## SUMMARY

With the use of an antimony electrode, 454 pH measurements were made in dental cavities in 56 subjects. The following observations were made:

1. Cavity pH was variable and ranged between 4.6 and 7.1, with 73 per cent of the cavities registering between pH 5 and 6.

2. A 10 per cent glucose rinse depressed cavity pH by 0.1 to 1.0 pH units within five to ten minutes. This was followed by a return to the starting value within 50 minutes.

3. A selection of four solid and one liquid foodstuffs raised cavity pH by 0.1 to 1.6 pH units within five to ten minutes. Only occasionally was any acid formation noted within 30 minutes after ingestion of foods.

**Table 8** • Effect of 0.1 molar phosphate buffer on cavity pH

| Cavity number | pH before adding buffer* | pH after buffering | | | | |
|---|---|---|---|---|---|---|
| | | 0 min. | 2 min. | 5 min. | 10 min. | 20 min. |
| | | | *1st buffering* | | | |
| 1 | 6.0 | 6.7 | 6.2 | 6.0 | — | — |
| 2 | 6.2 | 6.7 | 6.6 | 6.2 | — | — |
| 3 | 6.2 | 6.7 | 6.6 | 6.2 | — | — |
| | | | *2nd buffering* | | | |
| 1 | 6.0 | 6.7 | 6.2 | 6.0 | — | — |
| 2 | 6.2 | 6.5 | 6.2 | 6.1 | — | — |
| 3 | 6.2 | 6.6 | 6.6 | 6.2 | — | — |
| | | | *3rd buffering* | | | |
| 1 | 6.0 | 6.7 | 6.7 | 6.2 | — | — |
| 2 | 6.1 | 6.7 | 6.5 | 6.2 | — | — |
| 3 | 6.2 | 6.7 | 6.3 | 6.2 | — | — |
| | | | *1st buffering* | | | |
| 4 | 6.7 | 6.8 | 6.7 | 6.7 | 6.8 | 6.7 |
| 5 | 6.0 | 6.6 | 6.5 | 6.5 | 6.5 | 6.5 |
| 6 | 6.2 | 6.6 | 6.6 | 6.6 | 6.5 | 6.5 |

*At least 12 hours after eating.

4. The buffer properties and pH of the test foods were measured, and their acid neutralizing power is a partial explanation of their effect on cavity pH.

5. A strong acid reaction was found in some cavities, and attempts to buffer the carious material with 0.1 molar phosphate buffer in these cavities were unsuccessful. Other cavities were easily buffered.

*Sympathy and Understanding* • The dedicated practitioner in any of the healing arts knows that sympathy and understanding are just as important as scientific knowledge,—in fact he knew it in his heart even before he went to study his profession, and that is why he became a doctor. So now, in his practice, he tries to blend his science with his art. *H. B. Allman, Education, 1956.*

# New horizons in dentistry

*James R. Cameron, D.D.S., Sc.D., Philadelphia*

We are living today in a rapidly changing world. Geographically, distance remains as always, but improved methods of transportation and advanced means of communication have brought the remote parts of the world and their peoples in closer contact. Exchange of ideas for discussion and understanding now is brought about more easily.

Dentistry is also in a transitional state with the thoughts of what constituted dental practice in the past changing to embrace an ever-widening horizon. The purpose of this paper is to point out the newer concept of dentistry and the advances being made in dental education.

Dentistry is a comparatively young profession founded largely on the development of mechanical skill to repair or replace structures lost by disease or accident. The high degree of perfection in devising methods for replacing tooth structures has given American dentistry an enviable reputation throughout the world. Various dental practices as known in the past left imprints as stepping stones for advancement of the profession. Progress, however, is never static, and dentistry, like the older profession of medicine, constantly seeks to widen its horizon in conquering disease and reconstructing areas of congenital deficiencies or malformation. Increasing recognition by the public of the role that dentistry plays in promoting the health and welfare of people has brought the profession into a closer relation with that of medicine in taking a broader view and accepting a greater responsibility than was considered within a dentist's domain in the past.

Development of a broader educational program must overcome misconceptions as to the scope of dental practice. The autonomy of dentistry has long been recognized, and the laws of the 48 states give the profession certain rights and privileges separate and distinct from those governing the practice of medicine. The practice of dentistry is closely allied with that of medicine and some overlapping from one field into the other is bound to occur. The goal of the dentist is no different from that of the physician, as both strive to prevent disease, alleviate suffering and prolong life. The cordial relation between medicine and dentistry should continue.

It is unfortunate that within the past few years certain segments in the medical profession have brought about a situation somewhat embarrassing to both professions. The House of Delegates of the American Medical Association, in response to a minority group, attempted to define oral surgery and place restrictions on dental practitioners not holding a degree in medicine. It is not the prerogative of the medical profession to define a dental specialty or the practice of dentistry, and the definition of oral surgery now on the books of the American Medical Association is not acceptable to dentistry. It is the hope of the dental profession that the medical profession will see the error of its House of Delegates and have the definition removed. Dentists do not wish to practice medicine, but to practice den-

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tistry in accordance with the highest precepts and in accordance with the laws governing such practice.

The Joint Commission on Accreditation of Hospitals, by placing certain restrictions on dental practice in hospitals, has added further embarrassment to hospital administrators and medical staffs, and confusion to training programs in advanced dental education. The author has met with the members of a special committee of the previously mentioned Commission on several occasions and is fully appreciative of the job they face in raising the standards of hospital practice. The differences that have arisen between the Commission and the dental profession exist largely because of a lack of understanding by members of the Commission as to what constitutes dentistry and what dental education is accomplishing in raising the standards of dental training. It is believed that the Commission soon will have a better understanding of the newer concept of dentistry and seek to correct an unfortunate situation. In the meantime dentists might well consider putting their own house in order.

### DENTAL CAREERS OFFERED

Two World Wars and the Korean conflict emphasized the importance of dentistry in rendering and keeping men physically fit for the hardship and strain of battle. Teamwork by medical and dental officers in the armed services contributed much to stimulate and broaden the vision of civilian dentists and to provide an increasing influence in promoting higher dental education. Both medical and dental education have made tremendous progress during the postwar period largely because of the influence of those responsible for establishing the various training programs now in existence in the armed services.

The young dental graduate who enters the armed services for even as short a period as two years is fortunate, as the training he will gain under the guidance of experienced officers in the various branches of dental practice plus his contact with and observation of medical practice will make him develop a broader vision than he could obtain otherwise in a like period of time. His duties as a dental officer may take him to parts of the world where many diseases, both within the domain of dentistry and in the field of medicine, will be his to observe and record, all of which will broaden his knowledge and his concept of dentistry in relation to the body as a whole. The young dentist, planning a career in the armed services today, will enjoy many advantages that were not available to those of us who served in World War I. He will work with the latest type of equipment, and have offered to him postgraduate courses, internships and residencies in the several branches of dentistry. The continued expansion of the educational programs offered by the armed services, the freedom from competitive financial problems always present in civilian practice, and the knowledge that he will have financial security on retirement largely offset some of the minor disadvantages which exist in a mobile organization.

Another avenue open to the young dentist is a career in the United States Public Health Service where he will have the opportunity to broaden his concept of dentistry in relation to public health problems.

In civilian life the trend toward advanced dental education is being seen daily in the number of young dentists seeking admission to courses offered by various universities on the graduate level. The dental specialties of oral surgery and orthodontics have initiated and developed graduate training programs to qualify men for a broader practice than was formerly considered necessary to one limiting his practice to these two fields. Short postgraduate courses in these two

specialties serve well as refresher programs, but fail to cover adequately the fundamental instruction necessary in an expanding profession. As a result, these short courses are being supplanted by formal courses of study on the graduate level leading to a degree. These courses are designed to offer a well-organized course of study in the basic sciences as applied to dental practice. They also aid in preparing a student to meet the requirements of the specialty boards.

### DENTAL SPECIALTY REQUIREMENTS

Oral surgery, the oldest of the dental specialties, requires a minimum of five years of study for eligibility to take the rigid examinations for certification by the American Board of Oral Surgery. One year of this five year program must be spent in a basic science course, following which the trainee spends two years as a resident in oral surgery in an accredited general hospital maintaining an active oral surgery staff and service, and two years in clinical practice. During his two years of residency the oral surgeon has close association with the medical and surgical staffs and an opportunity to attend staff conferences where the treatment of patients is reviewed and evaluated.

Oral surgery was introduced as a major subject in the curriculum of the Philadelphia Dental College, now the School of Dentistry, Temple University, in 1864. Dr. James E. Garretson, its first professor, has the distinction of being the first professor of oral surgery to be appointed in a dental school in the United States.

Although oral surgery continued to expand as an important branch of dentistry, it was not clearly defined until September 1953 when the Board of Trustees and House of Delegates of the American Dental Association unanimously approved a definition which stated:

> The specialty of oral surgery is that part of dental practice which deals with the diagnosis, the surgical and adjunctive treatment of the diseases and injuries and defects of human jaws and associated structures.

This definition, formulated after a study of the Dental and Medical Practice Acts of all 48 states, gives a dentist desiring to specialize in oral surgery an understanding of what is required of a well-trained oral surgeon. In order to meet these requirements, a dentist will need training beyond that received in the undergraduate curriculum of a dental school.

The program in advanced education for those desiring to practice orthodontics requires an understanding of the basic sciences as applied to the growth and development of the facial structures. This branch of dentistry calls for constant observation of the growth and development of the child in relation to the behavior pattern of maxillary and facial development when aided by corrective measures. The day has passed when a dentist, confronted with an instance of malocclusion, can send a set of models of the patient's mouth to a laboratory and have a technician construct an appliance for correction of the deformity. The correction of malocclusion calls for knowledge of how the human body grows, and a keen insight and anticipation as to the manner in which a child may develop.

Orthodontics, like oral surgery, is an expanding field. The orthodontist and an oral surgeon working together in selected instances have, with their combined knowledge and skill, a tremendous opportunity to correct many of the deformities affecting maxillary structures which, when cared for independently, seldom obtain a satisfactory functional or cosmetic result.

Dentists interested in prosthetics beyond the construction and insertion of dentures have a tremendous opportunity to widen the scope of dental prosthesis

in the care of cleft palate deformities by constructing appliances based on the physiology of the speech mechanism. Children born with a cleft palate should not be considered entirely a problem of reconstructive surgery.

Treatment of such patients calls for careful evaluation of many allied problems and various areas of therapy, including prosthodontics and other branches of dental practice which would seem to be the answer in removing the social and economic detriment such patients must face throughout life if inadequately treated or completely neglected. Metallurgists and industrial chemists have given the prosthodontist a wide selection of materials with which to fabricate appliances for restoring appearance and lost function. Cleft palate rehabilitation is a challenge to dentistry and one which dentists should accept as a service to humanity.

### NEW ANESTHETICS AID PROGRESS

The tremendous progress made by surgery within recent years has been due in large part to the discovery of new and efficient anesthetics and an understanding of their behavior when introduced into the body. Improved methods of administration have opened the door for advancement in surgical technics to the extent that most any part of the human structure is now accessible for surgical exploration and procedure.

Anesthesiologists now offer to dentistry agents whereby many oral surgical procedures formerly considered hazardous may be performed under smooth and safe anesthesia. The term "anesthesiologist" should not necessarily be applied only to a graduate in medicine but also may be used to designate a dentist well-versed in the art and science of anesthesia. The newer methods of general anesthesia offer opportunity for the dentist to render skillful treatment in routine, painful dental procedures to patients who are uncooperative, or where local anesthesia is contraindicated or insufficient to permit careful operative management.

Endotracheal anesthesia has made it possible for a dentist to do routine restorative procedures for mentally retarded patients, and those who are victims of cerebral palsy. Routine cavity preparation and restoration of carious teeth by fillings can now be done at one operation when the anesthetic is administered by a skilled anesthetist. This opens a new field for the general practitioner of dentistry.

The demand will soon be such that hospitals may see the wisdom of providing for this type of dental service for even highly nervous, apprehensive patients and for high-pressured executives who find difficulty in keeping numerous dental appointments. Although a dental office is fully equipped for the practice of general dentistry, it is seldom a place for the satisfactory administration of prolonged general anesthesia. Restorative dentistry is time-consuming and, when a general anesthetic is to be used for such operative procedures, the patient deserves proper preoperative evaluation and postanesthetic observation which is more readily available in a hospital maintaining personnel skilled in the problems of anesthesia. This is not intended as a statement to discourage the use of general anesthesia in an oral surgeon's well-equipped office where it is customary to have trained anesthetists and equipment to assure proper postanesthetic care during recovery of the patient. It is felt, however, that lengthy anesthetic procedures for either surgical or restorative dental operations should not be attempted in an office. Complications may occur and every facility should be available for immediate correction.

### KNOWLEDGE OF THE USE OF ANTIBIOTICS REQUIRED

The use of antibiotics has changed the complexion of many dental disorders as they also have changed the complexion

of many diseases in the field of medicine. Serious infections of dental origin have been rendered less hazardous by the proper use of antibiotics. The highly toxic patient, developing a rapidly destructive, extensive osteomyelitis of the jaw, or the patient with a well-developed Ludwig's angina, secondary to an acute dental abscess, is no longer seen as frequently as before antibiotic therapy became available.

A knowledge of antibiotic agents and when to use them requires of the dentist some study of how they act and what might be expected by their use. The dentist should also be aware of possible serious or minor reactions to their use. The possibility of oral cutaneous and gastrointestinal disorders and how to combat them if they occur in hypersensitive patients is a prerequisite to their use. Valuable as the antibiotics are in reducing toxicity or in arresting a disease process entirely, the dentist must consider their limitations and not be led into a false sense of security by delaying necessary surgery. This is particularly true in instances of acute dental alveolar abscesses where fulminating, thick pus is confined within the heavy cortical bone. Extraction delay in such instances, even with massive doses of an antibiotic, often leads to migration of pus into deeper structures. This then requires incision and drainage which early extraction of the infected tooth would probably have prevented. Relying on antibiotics alone and delaying extraction or other surgical procedures often leads to a chronic migratory type of infection which may persist for months before being eliminated completely. Extraction of a tooth in the acute stage of an alveolar abscess should be done under general anesthesia. Depending on antibiotics to reduce the acute inflammatory process so that local anesthesia may be used could subject the patient to many possible complications.

Improved methods of endodontic therapy have made it possible to save many teeth showing evidence of chronic apical infection, but careful evaluation of such teeth and the patient's general condition is a prerequisite to successful treatment. The enthusiasm of some dentists in the newer type of root canal therapy as an aid to conserving teeth often leads to disappointment, because too much reliance was placed on endodontic treatment with little appreciation of behavior of bacteria and their toxins in hopeless conditions.

Oral medicine and periodontics are expanding their educational programs for better qualification of practitioners in these fields. Systemic diseases having oral manifestations may often be recognized in an early stage by a dentist before the patient seeks medical attention. Present day education of the dental student includes two years of study in clinical medicine. The training in physical diagnosis does not prepare the young dentist to treat medical problems, but rather to recognize them as they may manifest oral symptoms or be related to dental problems. With such training the dentist is equipped with knowledge that makes him conscious of the part he has in medical care.

Experienced dentists will agree that periodontal disease is responsible for the loss of more teeth than is caries or alveolar abscess. Research into the cause of periodontal disease provides an opportunity for the dentist possessing an investigative mind to work with similar minds in the fields of biochemistry, bacteriology, pathology and the various metabolic disorders. Research workers in the armed services are doing much work in this respect. At two of the large naval installations important projects are being carried out to determine the cause of this all too prevalent disease, and also that of dental caries. These two destructive diseases are not new by any means but research offers a broad and interesting field for dentists who have chosen a naval career or career in another branch of the armed services.

### ORAL MALIGNANCY OFTEN SEEN FIRST BY DENTIST

The frequency with which oral malignancy is being seen places a greater responsibility on the dentist than ever before. The dentist is the custodian of the oral cavity and his primary duty is that of a diagnostician. His training is such that his knowledge of oral pathology places him in a position to recognize diseased processes early because he usually sees his patient at frequent intervals. In the control of cancer the dental general practitioner and dental specialist have just as great a responsibility in the early recognition of oral cancer or precancerous lesions as has the physician in recognizing early or suspected malignancy in others parts of the body. Patients look to and depend on the family dentist for guidance in matters of oral health. Dentists are conscious of this responsibility and are accepting it as a part of their professional service.

With the education of the public as a means in the control of cancer, an increased responsibility is placed on the dentist which cannot be minimized. It is a grave obligation that the dentist faces in conducting an examination of the oral cavity. Such an examination calls for a careful inspection of the entire mouth and its contents, including the oral pharynx, and, in certain instances, the maxillary antrums and the depending lymphatics, in order that suspicious or obvious lesions may be evaluated and whether they are of local or metastatic origin. Procrastination regarding a questionable lesion, a wrong diagnosis or failure to recognize the existence of an abnormality may cost the life of a patient who had reposed confidence in the opinion of a dentist.

Many insurance plans now popular with the public extend recognition to dentistry as a health service. It is the responsibility of individual dentists to see that this recognition is not abused and therefore bring discredit on the profession.

### SUMMARY

Dentists practicing today are witnessing a complete change of attitude as to what constitutes dental practice. The broader educational requirements for a person desiring to study dentistry have raised the level of thinking in terms of social, political and professional responsibility. The distant horizon beckons to the dentist of the future in offering an expanding field of service. Education, however, is a slow process, and what may be considered a satisfactory standard of education today will seldom meet the requirements of tomorrow.

It took the American Society of Oral Surgeons nearly 15 years to appreciate the need for a board of certification as a means of raising the educational level for the training of oral surgeons. Since it began to function in 1946 the Board's standards have stimulated tremendous interest in the higher qualifications necessary for those desiring to practice oral surgery. Similar progress in other fields of dentistry and in medicodental relations is the result of this newer concept of education now available and attracting interest.

### CONCLUSION

Credit must be given to the Council on Dental Education of the American Dental Association for its untiring efforts to promote a higher standard of dental education on both the undergraduate and graduate level. With the progress now being made, dentistry will continue to merit greater recognition from allied professions and the public.

*269 South Nineteenth Street*

# The intramural practice plan in dental education (including a survey of American Dental Schools)

*Bruce L. Douglas, D.D.S., M.A., Rego Park, N. Y.*

One of the gravest concerns of dentistry, and more specifically of dental education, has been the continuous shortage of well-trained, full-time teachers in the dental schools of the United States. In place of the dentists who would make careers of dental education are large numbers of part-time instructors and professors who divide their time between teaching and private practice.

Dental education has not been able to compete successfully with the greater financial remunerations of private practice. Teacher income, in almost all fields, has failed to keep pace with the changing standard of living. The dental school, as a component of the university family, has suffered in the same manner as the other schools of the university; and, in some areas, university administrators and state legislatures have determined that dental schools should receive even smaller sums of money because of the belief that the school has a great degree of earning power through its clinical facilities.

The average full-time dental school faculty member who has no outside source of income finds himself in an unenviable financial position. The only solution to the problem is to find some means of raising faculty salaries to levels comparable with the income of private practitioners of dentistry. Until that time comes, other attempts undoubtedly will be made to provide an additional source of income for the dental faculty member. One such plan, the "intramural practice plan," was discussed at the Twelfth Congress on Dental Education and Licensure on February 4, 1956, in Chicago.

Shailer Peterson, secretary of the Council on Dental Education of the American Dental Association, made the opening remarks at the Congress.[1] He stated that the intramural practice plan "has been of more than a little concern to the (dental) examiners in several states." He pointed out that the schools which used this plan did so with the intent of "attracting faculty" and "for the purpose of permitting their faculties to continue to have practice experience." He mentioned that "in two states at least, the dental societies have been considerably concerned about the operation of such programs."

J. Ben Robinson,[2] dean of the School of Dentistry of West Virginia University, expressed the belief that, "Even in the face of extreme discouragement, and in

Holder of the Professional Diploma in Higher Education, Columbia University Teachers College.

1. Peterson, Shailer. Intramural practice plan for dental schools; introduction. J. D. Educ. 21:127 March 1957.

2. Robinson, J. Ben. Intramural dental teaching. J. D. Educ. 21:130 March 1957.

the presence of seemingly insurmountable difficulties, we must not lose sight of the ideal in dental education." The ideal depends in great part on the caliber of the teachers; whether they are well prepared academically, whether they have had adequate teaching or practice experience, and whether they have the leadership abilities "to assume the many teaching responsibilities involved in classroom, laboratory, and clinic instruction."

Dr. Robinson admitted that the difficulty in securing good teachers is caused "by lack of funds to pay reasonable salaries." He stated that "the stress of poverty has frequently caused dental educators to take unwise but expedient steps in order to finance their programs of dental education." "The university, or the state, or some form of outside philanthropy," he said, "must provide such funds as are required to pay salaries to dental teachers that will place their employment on a true full-time basis." He questioned whether "a bona fide, full-time dental teacher, employed on the professorial level, can divide his time satisfactorily between teaching in the dental school and conducting a reasonably remunerative private practice on the dental school premises in his so-called free time."

William H. Crawford,[3] dean of the School of Dentistry of the University of Minnesota, expressed the fear that, "If the university condones and encourages intramural practice, it then accepts practice income as a substitute for adequate salary, and once this has been done, what argument can be made for improved salaries? Such procedures add up to less adequate salaries and impaired teaching." Nevertheless, he accepted the reality of the problem with the statement: "New sources of income must either be found or a substitute such as intramural practice must be accepted."

James T. Ginn,[4] dean of the College of Dentistry of the University of Tennessee, and John C. Brauer,[5] dean of the School of Dentistry of the University of North Carolina, explained the working mechanism of two intramural practice plans presently in operation. Dr. Ginn emphasized that the problems of the plan "can be reduced to a minimum if they are anticipated in advance." "Supplemental income (which is limited, in his school, to 25 per cent or less of a teacher's total income) is not the only benefit derived from intramural practice for both the participant and the College." The experience in private practice, in Dr. Ginn's opinion, adds to the stature of the teacher, giving him "a better understanding and a keener insight into the problems of the practice of dentistry." Many of the outstanding, competent, full-time members of the University of Tennessee faculty could not have been retained, he felt, without the advantages of the intramural practice plan.

An intramural practice plan has served as an important part of the basic structure of the faculty of the School of Dentistry of the University of North Carolina. Dr. Brauer credits the acquisition of a large number of capable faculty members to the introduction of the plan at the beginning of the school's existence. As part of the primary aims and purposes of the program, Dr. Brauer explained, the school set out to attract to its faculty qualified young graduates and the more matured recognized practitioners, as well as qualified teachers from other institutions "by permissive salary supplementation via limited private practice in facilities provided by the University." Dr. Brauer expressed the belief that although it is not essential, it is most favorable to the plan to secure its endorsement by the local and district dental societies.

Dr. Brauer concluded:

3. Crawford, William H. The advantages and disadvantages of the intramural practice plan. J. D. Educ. 21:138 March 1957.

4. Ginn, James T. The intramural practice plan at the University of Tennessee. J. D. Educ. 21:146 March 1957.

5. Brauer, John C. The intramural practice plan at the University of North Carolina. J. D. Educ. 21:153 March 1957.

The opportunity for self-expression in private practice on the part of the faculty has been rewarding in the establishment of personal confidence, a greater professional stature among students and the profession, and a realization that their net incomes can be within the range of their fellow practitioners in non-academic fields.

## SURVEY

In an effort to determine the extent and success of the intramural practice plan in American dental schools, questionnaires were sent to the deans of all the schools. The following question was asked: "Do you provide any facilities for full-time faculty members to carry on a limited practice of a private nature within the confines of the school of dentistry?"

*Numbers and Percentage of Replies* • There were 45 operating dental schools in the United States at the time of the mailing of the questionnaire. Replies were received from 36 schools, 80 per cent of the total number.

*Numbers of Positive and Negative Replies* • Thirty of the school heads (83.3 per cent) stated that no intramural practice was carried on in their institutions, although one dean qualified this remark by stating, "except in the case of a couple of persons and to a very limited extent."

Six of the replying deans (16.7 per cent) answered in the affirmative. Two simply said "Yes" whereas four indicated that their schools had well organized intramural practice plans in operation.

*Analysis of the Negative Replies* • Of the 30 negative replies, two deans stated that plans were being formulated to start intramural practice plans in their schools; three stated that they had no objections to full-time faculty members practicing outside of school hours; 20 replied "No" without any explanation; one said that intramural practice was not included in his school because it was not properly equipped for it, and four deans were most emphatic in their condemnation of the plan.

*Quotations Accompanying Positive Replies* • Among the few positive replies, one dean stated that his school "had five fully-equipped offices which were available for limited private practice." Another explained the workings of a detailed program which provided a "maximum of ten hours per week with private patients, providing there is no interference with teaching responsibilities." The school furnishes all equipment and supplies. The operator sets his own fees and receives 50 per cent of them. Less than 50 per cent of the faculty members serving in a full-time capacity in this school avail themselves of this privilege. Another dean described an elaborate plan which, he said, was designed to attract capable men to the school and has succeeded in doing so.

*Quotations Accompanying Negative Replies* • A number of the deans who answered negatively explained their attitudes toward the intramural practice plan thusly:

"This in my opinion is not desirable. Teachers should be paid a decent salary to start with, although I certainly cannot compete with private practice on a financial basis. It is my impression, however, that good teachers can be found who enjoy the educational opportunities of teaching and will forego the financial rewards of private practice."

"I doubt whether such practice is legally permissible on the basis of tax-free facilities competing with private enterprise. There is difficulty in determining the extent of 'limited practice' without administrative supervision. There are conflicts in having different people using the same facilities."

"Our program is so designed that it would be difficult for instructors to arrange appointments that would not conflict with their teaching assignments."

COMMENTS

Although only six deans stated that intramural practice plans were in effect in their schools, the indications from the replies were that a number of others would like to put the plan into effect, providing the facilities were available. Twenty of the 36 replies (55.6 per cent) did not elaborate on their negative answers, which leaves some room for speculation on over half of the responses. The four negative replies which were accompanied by emphatic objections to the basic concept of the intramural practice plan indicated a firm belief on the part of those deans that the system was untenable in their teaching set-ups. One went as far as to say, "No, and the answer never will be yes."

It is of interest to note that two of the schools which have intricately designed intramural practice plans are very young and have utilized its appeal to faculty members as an important part of their program of growth and development.

OBSERVATIONS AND CONCLUSIONS

No detailed statistical analysis can be made from a relatively simple survey of this nature. The survey touches on numerous problems which relate to many socioeconomic aspects of dental practice. A large number of factors would have to be taken into consideration before a survey of this kind, which relates to such a wide range of problems, could be meaningful.

There is obviously a very practical group at one end of the analytical "bell-shaped curve" and a very conservative, highly idealistic group at the other end. There does not seem to be any immediate compromise between the two extremes, but it seems inevitable that the majority of schools will have to face the problem of providing additional sources of income for their faculty members if they are to compete successfully with the greater financial remunerations of private practice.

*93-08 Queens Boulevard*

*The Expanding Dimensions of Human Life* • During the first half of the twentieth century, we have witnessed modern man continually attempting to do what was foolishly impossible: he has been trying in cumulative self-contradictory ways to meet more time, more space, and more energy, with less personalism, less morality, and less religion.

Because of the extensive use of machinery, the elaborate division of labor, and the shortening of work schedules, man today has much more leisure time than formerly. Furthermore, the average span of life has been greatly increased during the last century. But what is he doing with this increased time? Is he adding richer quality to more quantity? Or is he wasting his new increments of time in selfishness, dissipation, and boredom?

If space be viewed as requiring the presence of energy matter, rather than as being merely a void, then we may truthfully say that even space itself keeps on expanding at tremendous speeds and in vast proportion. On our own planet, man has been able to roam over larger reaches of land, sea, and air, with ever swifter speeds, and we obtain at least a faint picture of our expanding reaction to space. But, here again, has man been making qualitative use of this new spatial quantity? Or is he merely using it as an area for vaster materialistic projections, many of which are destructive to human well-being?

For almost two centuries now man has been able to harness more and more physical energy. But what is man doing with this very greatly expanded energy? Is not the predominant emphasis also physical quantity rather than moral quality? For example, the bulk of atomic energy has been turned toward instruments of destruction rather than to constructive ends. . . .

Unless modern man can make very great improvements in personality development, moral integrity, and religious stamina, he may not be able to adjust himself successfully to the expanding dimensions of the atomic age.—*Elwyn Judson Trueblood, The Dawn of the Post-Modern Era, 1954.*

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LON W. MORREY, D.D.S., EDITOR
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# Dentistry faces keener competition in student recruitment program

The Council on Dental Education will report to the House of Delegates this month at Dallas that this year four per cent fewer students have applied for admission to freshman dental classes than in recent years. Whereas each year since 1946 there were two or more applicants for every place available in the freshman dental classes, the number has dropped to 1.9. This decrease is extremely small; nevertheless, if it denotes the beginning of a trend it should be a matter of concern to the dental profession. The continuing increase in population plus the increase in the public's appreciation of good dental health make it imperative that the profession continue to interest an increasing number of highly qualified young men and women to select dentistry as their life work.

It is hoped that the slight drop in student interest in dentistry is a temporary condition brought about by the overwhelming efforts of governmental and other agencies to encourage more American youth to enter technological fields. Commenting on this phase of what might become a serious national health problem if the dental student recruitment program is not maintained at a favorable level, President William R. Alstadt states:

"Dentistry is challenged by the increasing emphasis currently being placed on scientific and technical education for the American student; an emphasis deemed necessary to produce the engineers and technologists required to support our rapidly developing scientific way of life. Dentistry must re-evaluate its methods of introducing the high school and preparatory student to the advantages of a dental career.

"It is the responsibility of every dentist and of every dental society—local, state and national—to inform college entrants of the opportunities offered by a dental career. The dental profession is competing with industry and science for the nation's more qualified young men and women—individuals which dentistry must have if the profession is to continue its advancement and maintain its position in the healing arts.

"Dentistry cannot overlook this challenge. The public, in most instances, is poorly informed regarding the content of a dental education, what predental courses are required, and the special aptitudes needed by a student to become a dentist.

"It is becoming a custom in many high schools throughout the country to set aside one or two days toward the end of the senior year to acquaint the student with the many occupations he might choose as his life work. Representatives of these occupations are asked to inform the students of the requirements and potentials of the various professions, technologies, and businesses which they represent. Dentistry must take a more active part in these programs."

Although many dental societies have made it a practice to participate in vocational guidance programs, far too many dental societies have not. Every capable young student recruited to the dental ranks means one more member enlisted in the nation's health army—one more lifelong contributor to the nation's conquest for better health.

Dental societies that have not entered what is becoming an annual student vocational recruitment program are invited to write to the Association's Council on Dental Education for the several helpful brochures which it has available, particularly one entitled *A Dental Student Recruitment Program for Local Dental Societies.* Put the program into effect and in so doing render a distinct service to the community, the profession and the young men and women who select dentistry as a career.

## The therapeutic use of hypnosis

An exhaustive two year study of the medical use of hypnosis has recently been completed by the Council on Mental Health of the American Medical Association.[1] During its investigation, the ten member Council conferred with physicians, dentists and others outside the health fields who were known as experienced practitioners of hypnosis. Additionally, the Council reviewed some 113 scientific monographs and books published on the subject, including the report of the British Medical Association which appeared in the April 23, 1955, issue of the *British Medical Journal.*

The conclusions of the Council on Mental Health were essentially the same as those previously voiced on these pages. Some physicians and some dentists have the ability to hypnotize some, but not all, of their patients. The degree of success in each instance is modified by a number of intangibles, many of which are as yet not understood. No practitioner should employ hypnosis unless he has a thorough background of psychodynamic psychology and psychiatry, and recognizes how the phenomenon of hypnosis fits into that framework. Courses that limit their instruction to induction technics alone should be discouraged, and the use of hypnosis for entertainment purposes should be vigorously condemned.

Unfortunately, the induction of hypnosis is so simple, the Council points out, that it requires little or no technical skill or training, and thereby lends itself to exploitation by the charlatan. Even more serious, it permits the overenthusiastic dentist or physician, unschooled in its varied potentials, to employ it on all types of

unselected patients. The Council cautions: "No physician or dentist should utilize hypnosis for purposes that are not related to his particular specialty and that are beyond the range of his ordinary competence. As an example, a trained and qualified dentist might use hypnosis for hypnoanesthesia or hypnoanalgesia or for the allaying of anxiety in relation to specific dental work. Under no circumstances would it be proper for him to use hypnosis for the treatment of neurotic difficulties of his patient."

Although hypnosis may be a valuable therapeutic adjunct in the treatment in specific disorders, those who employ it, the Council warns, must be aware of the complexity of the phenomenon. Such awareness cannot be obtained by the mere attendance of courses limited to instruction in induction technics.

If the therapeutic use of hypnosis is ever to attain the respected status desired by its advocates, teaching of the subject must be under responsible medical or dental direction. Integrated teaching programs, the Council concludes, "should include not only the technics of induction but also the indications and limitations for its use within the specific area involved"—a conclusion with which THE JOURNAL heartily agrees.

1. American Medical Association, Council on Mental Health. Medical uses of hypnosis. J.A.M.A. 168:186 Sept. 13, 1958.

## First symposium on dental laboratory auxiliary services highly successful

Dental history was in the making September 29 and 30 when more than 90 representatives of the National Association of Dental Laboratories, the American Dental Association and its constituent societies conferred in the Central Office of the Association on matters of mutual interest. Prime discussion subjects included the education and certification of dental laboratory technicians, accreditation of dental laboratories, occupational licensing legislation, enforcement of the Dental Practice Act, the self-styled public denturists, regulation of Canadian Dental Laboratories, registration of Florida's dental laboratories and the education and recognition of medicine's associated technical groups.

In contents, attendance and audience participation the program, conducted by the Council on Dental Trade and Laboratory Relations, was highly successful. It had one fault. It was not held soon enough. More than a third of a century had elapsed since the House of Delegates of the American Dental Association was presented with a plan[1] to bring about closer relationship between the profession and the dental laboratory industry. Full thirty years have gone by since former president Henry L. Banzhaf advised the Association[2] that:

> The time has come when dental laboratories, organized for the purpose of assisting the members of our profession, should be recognized more fully and some form of regulation applied which would encourage those that are worthy of commendation. . . . I am not ready at this time to advocate the establishment of any requirements, educational or otherwise, for the individual technician, because I do not believe it is of public interest, since the technician does

not perform intraoral service, where or how such a technician acquired his ability to follow his vocation . . . however, I am interested in the character of the organizations that employ the technicians and in the desirability of supporting those that are worthy of recognition.

President Banzhaf was not alone in his contention. The Committee on Dental Education supported his position. Indeed, it went a step further regarding the education of technicians as evidenced in the report[3] of the Council's chairman, W. A. Giffen:

> **Although the need for expert dental technicians is growing rapidly, organized dentistry is doing nothing to meet the emergency . . . adequate courses in good technical schools, if developed under the guidance of local dental societies and with the cooperation of effective dental teachers, would presumably carry the problem toward its ultimate solution.**

The Committee on Dental Education concluded its report by suggesting that "a few of the dental schools should organize a department for training dental technicians and lady dental assistants." Twenty years elapsed before a dental school—the School of Dentistry, Ohio State University—initiated such a program. Ten more years slipped by before an acceptable certification plan for dental laboratory technicians was agreed upon by the American Dental Association and the National Association of Dental Laboratories.

The success which the dental profession and the dental laboratory industry have at last attained in ironing out the differences which have kept them so long apart can be attributed in no small degree to the cooperative efforts of the Council on Dental Trade and Laboratory Relations and the National Association of Dental Laboratories for which they are to be commended. It is hoped that the initial conference held last month will hasten the holding of further conferences which in turn will bring about closer rapport between the two groups and a more satisfactory dental health service to more people.

1. American Dental Association Transactions 1924, p. 93
2. American Dental Association Transactions 1927, p. 57
3. American Dental Association Transactions 1927, p. 76

# *International Correspondence*

## NEWS FROM GREAT BRITAIN

### BRITISH DENTAL ASSOCIATION

For the second time in the history of the Association, Dundee (Scotland) has accommodated the annual gathering of members. At the July Conference, the visiting members were able to enjoy themselves and were given every opportunity to do so. The Branch reception, which is always regarded as a forecast of the spirit of the Conference, made everyone feel that he was the guest of a considerate host, and the subsequent receptions by the civic authorities and the University of St. Andrews confirmed the accepted belief in Scottish hospitality. Even the weather decided that so important a gathering deserved sunshine and a pleasant temperature.

Although more time is customarily given to the academic part of the Conference than to business, the Annual Meeting of members is probably the most important event of the year. At this meeting any member may express his point of view on the report of the Representative Board and the balance sheet and statement of accounts. At the Extraordinary General Meeting the most controversial matter was the suggested alteration to the size of the Board. The decision of the meeting not to reduce the number of representatives doubtless will be found to be the wisest in the circumstances.

In the debate on whether the holding of a postal ballot for election to the Board should remain permissive or become obligatory, opposing opinions were strongly expressed and the majority decision to make the change will be a disappointment to some members.

This was a conference which for many reasons will live in the minds of those who were able to attend, and was a happy beginning to the presidential year of one who has for so long a time served the Association well. Though the meeting was not as large as some, the warmth of the hospitality, the excellence of the papers, demonstrations, and films, and the important decisions of the Annual and Extraordinary Meetings will long remain in the memories of those who were at historic Dundee.

W. R. Tattersall, in his presidential address, made the following remarks:

"Nowhere in the whole field of dentistry has there been in the last decade or two a greater advance than in the teaching in our dental schools. With the appointment of whole-time teachers it was to be expected that the standard would show a marked improvement, as indeed it has. It is to be hoped, however, that a place will continue to be found for the part-time teacher, who can play an important role in the scheme of things. It is one thing for the student to acquire, as he now does, a high standard of efficiency in the various operations he performs on the patient in hospital; it is another matter to learn how to deal successfully with patients in private practice. By introducing to the student some of the principles which go to make for success in that direction, the part-time teacher can be an asset."

Harry Davis, in his valedictory address, stated:

"The profession of dental surgery in Britain is in good heart, and the character of the men I have been honored to meet at Branch meetings has impressed me. In the company of such men there is every reason to be proud of being a dentist."

Some interesting and far reaching decisions were taken at the annual Conference. The motion not to reduce the size of the Representative Board defeated a resolution to cut the representation of each Branch by at least one person.

All future Board elections throughout the country will be by postal ballot. This will markedly increase the percentage of votes cast in any election. The meetings of Council will be every two months, rather than every month.

The Extraordinary General Meeting to decide on an increase in subscription to £9.9.0d per annum was scheduled to take place October 14 in London.

The annual Conference in 1959 will be held in Torquay May 25-29 under the presidency of Mr. G. Lotan Venning.

The Annual Conference in 1960 probably will be held in Edinburgh under the presidency of Mr. Duncan MacGregor.

### NATIONAL HEALTH SERVICE

In a letter dated May 6, 1958, the Ministry of Health replied to the proposals made by the British Dental Association for reforms in

the conditions of general dental practice in the Health Service. The reaction to the Ministry's letter was one of bitter disappointment and resentment at the meagerness of the concessions offered.

The Association, after extensive research and careful deliberation, had suggested reasonable and practical ways in which the Government might make a start in implementing these recommendations. The Ministry, on the other hand, appeared to have adopted an entirely obstructive role since, while rejecting almost everything suggested by the profession, they had produced no proposals of their own for honoring the moral obligations placed on them by the McNair Report.

### FLUORIDATION

The Borough Council of Andover has decided to end the fluoridation of the local water supplies. In view of the fact that the number of communities adopting fluoridation is increasing in other countries, and that it is being done on the advice of experts in many fields, this may well seem to be a retrograde step.

In the July 15 issue of the *British Dental Journal* there appears an article entitled "An Assessment of Some Objections to Fluoridation" by G. Wynne Griffith, M.D., D.P.H., County Medical Officer of Health for Anglesey, and this should be studied by all who are interested in fluoridation.

The question to be decided is not what are the "rights" of any section of the community, but whether or not expert opinion is that the appropriate addition of fluoride to a given water supply makes it more wholesome in the broadest sense. When this has been ascertained, the community has rights which authorities have the duty to satisfy.

### ITEMS OF INTEREST

Professor A. C. W. Hutchinson has been appointed visiting professor in diagnosis at the Northwestern University for a period of four months, beginning in October. He will teach in the department of diagnosis and the department of pathology and will be expected to give lectures to the student body and to the Faculty.

During the annual conference at Dundee Professor S. Lossius, dean of Oslo Dental School, acting on behalf of the King of Norway, conferred upon Professor J. Aitchison, dean of the Glasgow Dental School, the Order of St. Olaf. Professor R. Bradlaw, dean of the Sutherland Dental School, Newcastle, who was unavoidably absent, was also awarded this honor. Both schools have given valuable assistance in accepting Norwegian students for training and the deans have taken great personal interest in the students as individuals.

The many friends and colleagues both nationally and internationally will mourn the passing of "Danny" Rogers at the age of 90. Danny was one of the outstanding figures in the dental profession in Ireland where he was for many years dean of the Incorporated Dental Hospital in Dublin. Rogers belonged to that gracious period of Dublin life when the tempo of daily affairs permitted time to be devoted to the pursuit of the arts, to conversation, and to good living. He was a widower and leaves two daughters to whom we extend our sympathy.

*G. H. Leatherman,*
*D.M.D., F.D.S., R.C.S., F.A.C.D.*

# Association Affairs

## SYMPOSIUM ON DENTAL TRADE RELATIONS WELL ATTENDED

Over 90 persons attended the symposium on programs affecting relations between the dental profession and the dental laboratory group which was held recently at the Central Office. They represented a substantial number of the constituent and the larger component societies of the American Dental Association, State Examiners' Boards, the National Association of Dental Laboratories and the American Dental Trade Association.

Walter E. Dundon, chairman of the Council on Dental Trade and Laboratory Relations which sponsored the symposium, stated the objectives of the meeting. The first, he said, was the presentation of information on programs which have a significant impact on relations between the dental profession and the dental laboratory group, and secondly, the consideration and discussion of these programs by the members of the symposium audience.

The problems of licensure and registration of laboratory technicians were discussed in considerable detail. Bernard J. Beazley, secretary of the Council on Dental Trade and Laboratory Relations, said:

"The Council members could not detect any strong sentiment in the symposium audience for a change from the present long-standing policy of the Association on licensure and registration, and therefore will make no recommendations regarding re-affirmation, modification or change."

The Council will publish a number of the presentations at the symposium in forthcoming issues of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION.

## COUNCIL CITES LABORATORIES FOR SURVEY COOPERATION

At the meeting of the Council on Dental Trade and Laboratory Relations last month a resolution was passed commending the National Association of Dental Laboratories on the cooperation of its members in connection with the laboratory survey project which has been undertaken by the Association.

To date over 1,625 questionnaires have been returned, an unusually high percentage of returns for a survey, according to Bernard J. Beazley, secretary of the Council.

A second resolution was passed which commended the American Dental Trade Association on its continuing programs in the field of aid to dental education.

## GEORGE B. DENTON MEMBER OF F.D.I. HISTORY COMMISSION

George B. Denton, research consultant with the Bureau of Library and Indexing Service of the Association, has been named to a newly-formed subcommittee on dental history in the Scientific Commission on Dental Research of the Fédération Dentaire Internationale.

Dr. Denton, who served as a professor of dental literature and history at Northwestern University for 33 years, is consultant in nomenclature to the F.D.I. He has been in charge of the nomen-

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Large turnout at the symposium on programs affecting relations between the dental profession and the dental laboratory group is shown. The sessions were held at the Central Office Sept. 29-30. In upper corner (l. to r.): Robert E. Paulsen, executive secretary, Washington State Dental Association; Bernard J. Beazley, secretary, A.D.A. Council on Dental Trade and Laboratory Relations; Homer Dickson, president, National Association of Dental Laboratories; J. Eugene Ziegler, member, Council on Dental Trade and Laboratory Relations; Walter E. Dundon, chairman of the Council; Don W. Gullett, secretary, Canadian Dental Association; J. Fred Folley, member, Council on Dental Trade and Laboratory Relations, and Robert B. Hughlett, representative of the Florida State Board of Dental Examiners.

clature project of the Bureau of Library and Indexing Service and is the author of the recently published *Vocabulary of Dentistry*. He is also working with Donald Washburn, bureau director, on the organization of the Association archives.

The new F.D.I. subcommittee will collect and coordinate historical material on dentistry and further the promotion of original research in this field.

The first annual meeting of the group will be held in New York City in September 1959.

## H. TRENDLEY DEAN NAMED ONE OF 12 OUTSTANDING DENTISTS

Another honor has come to H. Trendley Dean, secretary of the Association's Council on Dental Research, and former director of the National Institute of Dental Research, USPHS.

Dr. Dean has been included among the "12 outstanding dentists" of the United States in a permanent photographic exhibit in the University of Haiti Dental School, Port-au-Prince, Haiti. The selection, made by the National Library of Medicine, includes Joseph L.

Bernier, Kenneth Easlick and J. Ben Robinson, as well as eight deceased members of the profession: John Greenwood, Horace H. Hayden, Solyman Brown, Eleazar Parmly, Chapin Aaron Harris, Horace Wells, Greene Vardiman Black and William J. Gies.

Dr. Dean's reputation is worldwide as a pioneer in fluoridation research. He is the recipient of many honors and awards and the author of over 60 articles on dentistry and public health. He is former president and trustee of the International Association of Dental Research and former vice president of the Fédération Dentaire Internationale.

Facsimile of the Relief Fund Seal issued for the 1958-59 annual campaign. The seals, printed this year in striking teal blue and orange, have been mailed to all Association members.

## MEMBERSHIP CARDS IMPORTANT FOR SESSION REGISTRATION

Once again Association members planning to attend the annual session in Dallas are reminded to have their membership cards with them. The cards are required for registration and to gain entrance to the scientific program.

Expense deductions for income tax purposes can be claimed if membership cards are stamped indicating attendance at the session, according to the Internal Revenue Department.

## 1959 EDITION OF "ACCEPTED DENTAL REMEDIES" READY

Owing to the fact that all available copies of the two printings of the 1958 edition of *Accepted Dental Remedies* were distributed by mid-September this year, the schedule for the 1959 edition of the book was advanced, according to J. Roy Doty, secretary of the Council on Dental Therapeutics of the Association.

Copies of the 1959 edition will be available November 1 and may be obtained from the Order Department, Central Office, 222 E. Superior St., Chicago 11. The price of the book remains $3.

## RELIEF FUND DRIVE BEGINS, SEALS MAILED TO MEMBERS

Reminders that the 1958-59 campaign for contributions to the American Dental Association Relief Fund, in the form of the traditional Relief Fund seals, are in the mails.

H. R. Bleier of Milwaukee, chairman of the Council on Relief, has expressed the hope that all dentists respond even more generously and more promptly than they have in the past. He pointed out that last year's average contribution was $4.44 and asked that this year efforts be made to make the average $5 or more.

Last year dentists throughout the nation gave a total of $121,929.28 to the fund. Contributions should be forwarded to the A.D.A. Relief Fund, 222 E. Superior St., Chicago 11.

## R. H. FRIEDRICH NAMED TO HEALTH FORUM COMMITTEE

Rudolph H. Friedrich, secretary of the Association's Council on Dental Health, has been named a member of the program planning committee of the National Health Forum and annual meeting.

The joint sessions, sponsored by the National Health Council, will be held

March 16-20 in Chicago. The Forum theme will be "Occupational Health."

Harry H. Dougherty, Wyomissing, Pa., a member of the Association of Industrial Dentists, is also a member of the program planning committee.

### LON W. MORREY FETED FOR 25 YEARS OF SERVICE IN A.D.A.

Twenty-five years with the American Dental Association were marked October 16 by Lon W. Morrey, editor.

The Central Office staff held a reception for Dr. Morrey at which time he was presented with a scroll containing the signatures of the entire staff. He also was given a silver tray, the Association's traditional silver anniversary gift, on behalf of the Trustees and membership.

Dr. Morrey was graduated from Loyola University School of Dentistry in 1923. After a period of years spent in private practice and as director of the dental division, Illinois State Department of Public Health, and the Chicago Board of Health, he became director of public relations in 1933 for the American Dental Association. In 1947 he became editor of the Association, assuming responsibility for the JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, JOURNAL OF ORAL SURGERY, and DENTAL ABSTRACTS.

### DALLAS HEALTH MUSEUM OF INTEREST TO ALL DENTISTS

The facilities of one of the finest health museums in the country will be made available to all dentists attending the annual session of the Association in Dallas.

The Dallas Health Museum, second only to the Cleveland Health Museum, is located in Fair Park, Dallas 10. All who are interested in the field of health should not miss the opportunity to go through this interesting building.

### TECHNICIANS BOARD'S BYLAWS AVAILABLE IN BOOKLET FORM

The bylaws of the National Board for Certification of dental laboratory technicians, which were approved by the Council on Dental Education in May, have been printed by the Board.

Copies are available on request to: Paul Slone, executive director, National Board for Certification, 201 Mills Bldg., Washington, D. C.

## Dental Societies

### DENTAL HEALTH WORKSHOP HELD BY INDIANA SOCIETY

Three areas of public dental health were considered at the Centennial Year Workshop conducted by the Indiana State Dental Association recently at the Purdue University Memorial Union. They were: "Dental Health Aspects of Public Welfare," "Community Dental Health Education" and "Group Purchase of Dental Services."

About 150 persons attended the conference, chairman of which was Charles L. Howell, Indiana state dental director. Agreement was reached on several recommendations covering such subjects as fee-information surveys at both the state and local levels; the need for top priority to be given to children's dental care and to emergency care; liaison between the dental society and the welfare department at both the state and county levels, and many others.

Annual meeting of the Colorado State Dental Association was held last month in Colorado Springs and honored Frederick S. McKay, pioneer researcher in dental fluorosis. Seated at the speakers' table were (l. to r.) George Dwire (speaking), president of the Colorado State Dental Association, Harold Hillenbrand, A.D.A. secretary, W. W. Bauer, director of health education for the American Medical Association, John Knutson, chief dental officer of the U. S. Public Health Service, Stephen McNichols, governor of Colorado, and Dr. McKay.

## COLORADO'S ANNUAL MEETING HONORS FREDERICK S. McKAY

The Colorado State Dental Association held its annual meeting October 6 at Colorado Springs and saluted Frederick S. McKay, whose scientific curiosity a half century ago paved the way for water fluoridation.

Joining in the ceremonies honoring Dr. McKay were Stephen McNichols, governor of Colorado, John W. Knutson, chief dental officer of the U. S. Public Health Service, W. W. Bauer, M.D., director of health education for the American Medical Association, Harold Hillenbrand, Association secretary, and others.

In 1908, under the auspices of the Colorado Springs Dental Society, Dr. McKay began an investigation into the cause of mottled tooth enamel. His studies, largely supported by his personal funds, ranged throughout a large part of the United States and Europe. He found that traces of fluorides in drinking water had a relationship to tooth decay.

Speaking on behalf of the more than 90,000 members of the Association, Dr. Hillenbrand described water fluoridation as one of the great public health measures of modern times.

Frederick S. McKay (center), inspects the citation he received from George Dwire (left), president of the Colorado State Dental Association, as W. W. Bauer of the American Medical Association looks on.

Governor McNichols reported that approximately 90 per cent of the public water systems in Colorado contained the recommended amounts of fluorides.

Dr. McKay was presented a citation

by George J. Dwire, president of the Colorado State Dental Association. After attending Boston Dental College, Dr. McKay was graduated from the University of Pennsylvania School of Dentistry. He has held office in many local, state and national dental groups and is a life member of the American Dental Association and International Association for Dental Research, as well as an honorary member of many other associations.

Dr. McKay has taught and lectured on orthodontics, oral surgery and oral hygiene and is consultant on dental fluorosis to the U. S. Public Health Service. He has had many papers on the subject published since the first description of mottled teeth in the literature of dentistry was published in *Dental Cosmos* in 1916 under joint authorship with G. V. Black.

Dr. McKay has a private practice in Colorado Springs.

## EAST COAST DENTAL SOCIETY MIDWINTER MEETING JAN. 9-10

Two days of scientific sessions featuring Marvin E. Mundel of Milwaukee and John Anderson of Chicago will constitute the annual midwinter meeting of the East Coast Dental Society January 9, 10 in Miami, Fla.

Drs. Mundel and Anderson will speak on time and motion studies as related to dentistry and efficient office operation. There will also be an analysis of bite recording technics by Russel Jones, technician, of Cleveland, Ohio.

The meeting will be held at the DuPont Plaza Hotel.

## CENTRAL DENTAL ASSOCIATION PLANS FIRST ANNUAL MEETING

The Central Dental Association, under the presidency of Emory H. Powell, will hold its first annual meeting January 18-21 at the Big Mountain Lodge, Whitefish, Montana. The newly-formed group is comprised of dentists from Colorado, Minnesota, Montana, North Dakota, South Dakota, Wisconsin and Wyoming.

An invitation to all American Dental Association members to attend is extended by the secretary, R. E. Baker, 828 Lowry Bldg., St. Paul 2, Minn., from whom further details may be obtained.

## NEW JERSEY HOLDS ITS FIRST DENTAL HEALTH CONFERENCE

At the first dental health conference of the New Jersey State Dental Society last month the general theme of better dental care for more people was explored. This covered the necessity of expanding public appreciation of good dental health care and discussion of methods of meeting costs.

Among the recommendations arrived at was one stating that postpayment plans provided one of the best opportunities of providing the best dental service to the greatest number of people, and calling for a statewide survey on payment plan statistics.

Among the speakers at the sessions were Rudolph H. Friedrich, secretary, A.D.A. Council on Dental Health, and Mr. Perry Sandell, director, Bureau of Dental Health Education. John G. Carr, state society secretary, was in charge of general arrangements.

*Subscripts* • Dental societies in some states have received queries from the Reuben H. Donnelley Corp., publishers of telephone book advertising, as to their stand on group display ads of dental laboratories. The Pennsylvania Dental Association has replied pointing to the resolution adopted by the 1957 A.D.A. House of Delegates at Miami Beach. The resolution states:

"Resolved, that the American Dental Association is strongly opposed to the direct

Looking over the program for the Eighth Annual District Officers Conference of the Michigan State Dental Association held in September at Lansing are, l. to r., J. P. Boukema, MSDA president; P. H. Jeserich, A.D.A. Ninth District Trustee; P. J. Ross, conference chairman, and Herbert B. Bain, director of the A.D.A. Bureau of Public Information, who was the keynote speaker at the conference.

promotion to the public of any equipment, dental materials or any other product, the selection of which is exclusively the dentist's responsibility." . . . Court decisions in the states of Utah and Oklahoma have been issued recently which are favorable to dental laws in those states. These are in direct opposition to the unfavorable court action in Idaho in 1955.

## Public Health

### FLUORIDATION PROGRAM IS A PHILADELPHIA SUCCESS STORY

Even greater protection against tooth decay than was originally expected is the outcome of the first four years of fluoridation in Philadelphia.

A report from the city's Health Commissioner, James P. Dixon, states that the number of cavities in school children has been cut more than half and tooth extractions have been reduced by 43 per cent.

On the basis of the study just completed, experts believe that at the end of six years reduction of tooth decay among school children will be more than the anticipated 60 per cent.

Dr. Dixon said that fluoridation costs Philadelphians $120,000 a year, but saves the city's residents $1,000,000 a year in dental costs.

### COURSES IN PUBLIC HEALTH DENTISTRY SET IN BRAZIL

A survey completed last year by the Pan American Sanitary Bureau, WHO Regional Office for the Americas, revealed an acute shortage of public health dentists in the majority of countries in the Region.

An agreement has been concluded between this agency, the University of São Paulo (Brazil), and the Kellogg Foundation for the provision of public health

*Fluoridation Scoreboard* • The city council of Charlottetown, Prince Edward Island, Canada, has unanimously approved a resolution calling for fluoridation of its municipal water supply.

The President's Citizens Advisory Committee on the Fitness of American Youth which recently held its second annual meeting at Fort Ritchie, Cascade, Maryland, included two representatives of the American Dental Association. They were C. Willard Camalier, assistant secretary of the American Dental Association (third from left), and Fritz A. Pierson, 11th District Trustee (right). Others in picture are (from left), Dr. Frank Berry, Assistant Secretary of Defense (Health and Medical), Charles C. Finucane, Assistant Secretary of Defense, Col. James J. Winn, Commanding Officer of Fort Ritchie, and Dr. Frank Bohn, observer.

dentistry courses at the University's school of public health.

The courses are open to students from other Latin American countries as well as Brazil.

Other agencies are cooperating by providing guest lecturers to extend the range of the courses. Thus the U. S. International Cooperation Administration adviser to the Brazilian Special Public Health Services is teaching technics based on time-and-motion studies and designed to eliminate wasteful movements in dental practice.

## International

### JAPAN DENTAL ASSOCIATION BIENNIAL MEETING IN TOKYO

Toshio Kashima, managing director of the Japan Dental Association, has extended an invitation to all members of the American Dental Association to attend and participate in the biennial meeting of the group April 26-28 in Tokyo.

Essays and clinics by American dentists have been a noteworthy part of these meetings in the past. A group of 52 dentists and their families participated in the last meeting.

Applications should be sent to The Institute of Pacific Seminars, 578 Grand Ave., Oakland 10, Calif.

### F.D.I. ANNOUNCES SECOND MEMORIAL PRIZE CONTEST

The second award of the Albert Joachim Quinquennial International Prize will be made in 1962 by the Fédération Dentaire Internationale.

Candidates, who must be legally qualified to practice dentistry or hold a university degree in science, must submit an original and unpublished thesis on scientific research of a laboratory or clinical

nature in the field of odonto-stomatology carried out not longer than five years previous to July 1961. The thesis may be written in French, German, Italian, Spanish or English, and may not exceed 10,000 words.

Five copies of the thesis and of the summaries in each of the other languages must reach the Secretary General of the F.D.I., 35 Devonshire Place, London, W.I., by July 1, 1961.

The name of the winner of the prize, who will also receive a medal, will be announced during the 13th International Dental Congress in Cologne in 1962. The prize will consist of 50,000 Belgian francs.

## COSTA RICAN DENTAL SOCIETY ELECTS OFFICERS FOR 1958-59

The following roster of officers has been elected for the 1958-59 period by the Asociación Odontológica de Costa Rica:

Raymond Pauly S., president; Ramon Garcia V., vice-president; José J. Ulloa G., secretary; Norma Zeledon P., treasurer; Fernando Muñoz S., fiscal officer; Guillermo Pacheco G., Clodomiro Mora R. and Julio Jurado del Barco, voters.

Dr. Pauly was a recent visitor to the Central Office in Chicago, where he extended an invitation to Harold Hillenbrand, Association secretary, to attend the 2nd International Convention of the Federacion Odontológica de Centro América y Panamá which will take place in San José, Costa Rica, November 25-29. All Association members are cordially invited to attend this convention.

## AUSTRALIAN DENTAL CONGRESS SCHEDULED AT ADELAIDE

The University of Adelaide and the School of Mines, Australia, have granted use of their facilities for the 15th Annual Australian Dental Congress which will be held February 23-27.

Highlighting the scientific program will be a group of dental essayists and clinicians from the United States and Canada of whom the principal guest lecturer will be Bertram H. Downs of Colorado Springs. This group will be limited to 20 and applications from dentists interested in presenting either essays or clinics should be directed to the Institute of Pacific Seminars, 578 Grand Ave., Oakland 10, Calif.

William A. Elsasser of San Francisco has been designated by the Australian Dental Association as the program chairman responsible for organizing the professional agenda involving participation by American and Canadian dentists. Correspondence to him should be addressed to the Institute of Pacific Seminars.

Canadian and American dentists who would like to attend the meetings must be limited to ten and applications will be filled on a "first come, first served" basis. Families and friends, however, of the 20 essayists and clinicians and the ten dentists who will register for the meetings without presenting an essay or clinic, are invited to participate in the social, sightseeing, and personal events associated with the program.

Dentists may make arrangements with the Institute of Pacific Seminars as independent travelers or may join a special vacation tour party which will include planned tours of Australia, New Zealand and Fiji, as well as the Dental Congress itself.

A World Health Organization Dental Seminar will be held in Adelaide during the two weeks prior to the Congress. Participants will remain to take part in the session activities.

## NETHERLANDS HEALTH OFFICER PLANS USE OF DENTAL NURSES

Word has been received at the American Dental Association Central Office that the Minister of Social Affairs and Public

Health of the Netherlands has informed the Dutch Parliament of his intention to introduce an auxiliary of the New Zealand dental nurse type into the school dental services.

The Netherlands Dental Association has not been consulted in this matter.

### NAIR DENTAL COLLEGE, BOMBAY, CELEBRATES SILVER JUBILEE

One of the largest dental colleges in the eastern part of the world, the Nair Hospital Dental College in Bombay, India, will celebrate its silver anniversary next month.

The college has an enrollment of about 250 students and the institution gives dental care to about 70,000 needy patients each year. It is affiliated with Bombay University and its present building was built in 1952 on land donated by the late Dr. A. L. Nair.

In conjunction with its silver jubilee, Nair Dental College is embarking on a campaign for funds to create scholarships for deserving students, create research grants to advance dental science, and furnish recreational facilities to provide relaxation for the students.

Donations to the fund may be sent to "The Nair Hospital Dental College, Silver Jubilee, C/o Hon. Secretary, Dr. A. L. Nair Road, Bombay 8, India.

### BRITISH DENTAL RADIOLOGY SOCIETY ESTABLISHED

Representatives from the radiology departments of dental schools and hospitals in the United Kingdom met recently at the Royal Dental Hospital, London, under the chairmanship of Sydney Blackman, to form the British Society of Dental Radiology.

The objects of the society are the advancement of understanding and appreciation of the value of dental radiology, the promotion of its study and research, the promotion of study of roentgenographic interpretation and technic, and to establish dental radiology as a specialty. Its members wish to press for the creation of a Diploma in Dental Radiology to be registrable as an additional qualification.

A program is being arranged for meetings to be held during 1959 for the presentation of scientific papers.

Further particulars may be obtained from Mr. Guy Poyton, F.D.S., X-Ray Department, Eastman Dental Hospital, Gray's Inn Road, London, W.C.I., England.

### PHILIPPINE DENTAL SOCIETY NEEDS FUNDS FOR BUILDING

Plans for a permanent headquarters for the Philippine Dental Association, long in the making, are being pushed as the need intensifies.

Philippine dentists are attempting to raise a trust fund for its construction now that they are virtually assured that their government will allocate space for such a building.

The fund has been launched by a personal donation from Gervasio Eraña, who will attend the 99th annual session of the American Dental Association in Dallas this month as a representative of the Philippine Dental Association.

The president of the Philippine society, Dominador G. Santos, has sent an urgent appeal through Dr. Eraña for help from American dentists in raising money for this badly needed building.

Contributions should be sent directly to Dr. Santos, President, Philippine Dental Association, P. O. Box 1142, Manila, Philippines.

### INTERNATIONAL ACADEMY OF ORAL PATHOLOGY FORMED

With a goal of greater interchange of knowledge and concepts between peoples

of different nations, the International Academy of Oral Pathology has been formed.

This organization has as its aim the pursuit of scientific knowledge to which end periodic international conferences are planned to discuss theories, concepts, and research endeavors relating to oral disease.

Fifty fellows will ultimately constitute the entire organization and membership in the Academy will be by invitation. A founding group of seven internationally known oral pathologists have accepted fellowship in the Academy and are actively engaged in the discussion of procedural policies.

Joseph L. Bernier, chief of oral pathology, Armed Forces Institute of Pathology, Washington, D. C., will serve as secretary and will, from time to time, announce further activities of the organization.

## SWISS FAMILY DENTAL SURVEY SHOWS POOR HABIT PATTERNS

During the year 1957, a mail survey was conducted by the Swiss Dental Association in order to find out what the average Swiss man and woman believe in regard to dentists, dental technicians, dental care and oral hygiene.

One thousand questionnaires were mailed at random to families residing in the various cantons, thereby including persons of German, French and Italian ancestry. About 500 questionnaires were returned, filled out mainly by housewives.

The following data were recorded according to the answers received:

1. Fifty per cent of the children and 28 per cent of the adults use toothbrushes and dentifrices only irregularly, that is less than once a day.

2. Twenty-seven per cent of the adults (24 per cent of the men and 31 per cent of the women) wear some type of denture or bridge.

3. More than one third (38.1 per cent) of the adults believe that dental treatment and care of the deciduous dentition are unnecessary.

4. About one third (28.7 per cent) of the children eat some kind of sweets regularly, between meals and before going to bed.

5. About 50 per cent of the children take fluoride tablets and cod-liver oil preparations regularly.

6. Of the more than 500 family members included in the survey, 56 per cent of the men and 61 per cent of the women claim to have visited a dentist at least once during the last year. More than 75 per cent of the children, however, have never received any kind of dental treatment.

7. The great majority of men and women (87.6 per cent) state that they are satisfied with their dentists and have no complaint in regard to dental treatments or fees.

Although the data compiled are not conclusive for the dental condition of the entire Swiss population, the picture of dental health thereby received is far from satisfactory.

## GYSI MEMORIAL LECTURE TO BE GIVEN IN NEW YORK

A memorial lecture to the late Professor Dr. R. A. Gysi will be given by one of his Swiss colleagues at the time of the 47th annual meeting of the Fédération Dentaire Internationale in conjunction with the centennial celebration of the American Dental Association in New York in September 1959.

At the 46th annual meeting of the F.D.I. in Brussels in August, it was agreed that the Commemoration Fund established in honor of the memory of Dr. A. E. Rowlett, president of honor of the Federation, be reopened and subscriptions received in memory of Pro-

fessor Dr. Gysi also. This fund furnishes a prize to be awarded for a lecture recording the life and work of a distinguished member of the odonto-stomatological profession on his death.

Candidates to deliver the lecture are selected by the Council of the F.D.I., preferably from the country where the deceased lived.

### BOMBAY INSTITUTE PLANS DIAMOND JUBILEE PROGRAM

The Haffkine Institute of Bombay, India, will celebrate its diamond jubilee anniversary starting January 10, 1959, with scientific meetings discussing medical and dental conditions of India.

Members of the American Dental Association are invited to attend these meetings and to take part in the scientific programs.

Details of the meetings, the planned program, and the work of the Institute will be given in the December issue of THE JOURNAL.

## Research

### BIDS FOR N.I.D.R. BUILDING TO BE REQUESTED NEXT MONTH

Plans for construction of the new building to house the National Institute of Dental Research have been drawn up and bids will be asked for on December 4 according to the present schedule.

Completion of the building, expected to be in the fall of 1960, will climax a ten year drive on the part of the American Dental Association for such a project. The $3,700,000 building which will furnish adequate working space and facilities for dental research was provided for in the appropriations bill of the Department of Health, Education, and Welfare that President Eisenhower signed shortly before the 85th Congress adjourned.

According to present plans construction bids will be opened January 15, 1959, and construction will begin in February. The schedule calls for completion in about 500 calendar days.

In a forthcoming issue, the JOURNAL will publish architects' renderings of the building.

### THREE EUROPEAN SCHOLARS TO DO RESEARCH AT HARVARD

Three European scholars who specialize in research concerned with dental medicine have joined the staff of the Harvard School of Dental Medicine for periods of study under a Fulbright travel grant.

Robert Maurice Frank of the Dental Institute, Faculty of Medicine, Strasbourg, France, will serve as a research associate in oral pathology through July 1959.

Philip John Holloway, a member of the scientific staff of the Medical Research Council, London, will serve as a research Fellow in dental medicine through August 1959.

John Crosby Ritchie, orthodontic specialist to the Westminster Group Hospitals, London, will work on a study of American methods directed toward the group approach in the treatment of cleft palate cases through January 1959.

### GRANTS FOR DENTAL RESEARCH FACILITIES MADE BY U.S.P.H.S.

Three grants for increasing dental research facilities have been made by the Public Health Service of the Department of Health, Education, and Welfare. The grants are the second group of awards made possible by this year's appropriation of 30 million dollars to encourage further expansion of the nation's health research facilities.

The Forsyth Dental Infirmary for Children, Boston, will receive $154,544 for the remodeling of a dental research facility. Washington University, St. Louis, Mo., has been awarded $200,000 for laboratories for dental research, and the University of Oregon, Portland, was granted $9,877 for a dental research facility.

### DENTAL RESEARCH BUILDING DEDICATED AT PENNSYLVANIA

One of the few school buildings in the country devoted exclusively to dental research was dedicated last month at the University of Pennsylvania School of Dentistry.

Ceremonies dedicating the $250,000, three-story, brick building were climaxed by a dinner honoring Joseph L. T. Appleton, Jr.

Among those participating in the ceremony and dinner were Dr. Gaylord P. Harnwell, university president; Lester W. Burket, dean of the dental school; Charles H. Patton, Association Trustee; John Knutson, assistant surgeon general of the U. S. Public Health Service; Harold Hillenbrand, A.D.A. secretary; Thomas J. Hill and H. Trendley Dean, chairman and secretary, respectively, of the Council on Dental Research, and LeRoy E. Ennis, member of the Council on International Relations.

## Dental Education

### FELLOWS IN DENTAL MEDICINE PICKED FOR HARVARD PROGRAM

Five postdoctoral Fellows in dental medicine have been selected to participate in a postgraduate program at the Harvard School of Dental Medicine involving patient care, teaching and research.

The Harvard program, which is sponsored in part by the United States Public Health Service, is now in its second year. The first group of five Fellows were admitted in 1957. Each Fellow will spend three years at the School of Dental Medicine as he broadens his professional experience through increased research and teaching activities and the care of patients.

The postdoctoral program is conducted by the Harvard School of Dental Medicine in collaboration with the basic science departments of the Harvard Medical School and with affiliated dental clinics at the Forsyth Dental Infirmary for Children, The Children's Hospital and the Massachusetts General Hospital.

The Harvard School of Dental Medicine program is supervised by Reidar Sognnaes, professor of oral pathology.

### RESIDENCY IN ORAL MEDICINE AVAILABLE AT MONTEFIORE

The dental department of Montefiore Hospital, New York, announces a residency in oral medicine from July 1, 1959, through June 30, 1960. The course of study is integrated with various departments of the medical and dental faculty.

Inquiries and applications may be made to: Dr. David Tanchester, chief of dental service, Montefiore Hospital, Gun Hill Rd., New York 67.

### INTERNSHIP AND RESIDENCY AT MEMPHIS V.A. HOSPITAL

The Veterans Administration Medical Teaching Group Hospital of Memphis, Tennessee, has openings for one rotating dental intern and a residency in prosthodontics available for the year beginning July 1959.

Information and application forms may be obtained from the chief of the dental service of the hospital.

### RALPH IRELAND MADE DEAN AT NEBRASKA DENTISTRY COLLEGE

Ralph L. Ireland, former chairman of the department of pedodontics at the College of Dentistry, University of Nebraska, became the fourth dean of the college on July 1, 1958. He had served as director of graduate and postgraduate studies in dentistry at the university since 1947.

Dr. Ireland, a member of the American Society of Dentistry for Children, was that group's president from 1940 to 1944. He is active in the American Academy of Pedodontics and a past president of that society. He is a member of the International Association of Dental Research, a diplomate of the American Board of Pedodontics and a Fellow of the American College of Dentists.

### TRIBUTE TO JOSEPH LANDA TO BE GIVEN BY N.Y.U. DIVISION

Joseph S. Landa will be honored for his 33 years as a teacher, clinician and researcher in dentistry by the postgraduate division of the prosthetic department of the New York College of Dentistry.

A reception and dinner will be held Thursday, January 22, 1959, at the Hotel Belmont Plaza, under the chairmanship of Sidney I. Silverman. Dean Raymond J. Nagle, honorary chairman, said:

> New York University is proud of Dr. Landa's many years of affiliation with the College of Dentistry and acknowledges his outstanding contribution to the recent advances in the new biologic character of dental education and the clinical practice of dentistry. His research work and enthusiasm have sparked the future of dentistry and he has illuminated new pathways for our future generation of dentists.

### MOUNT SINAI HOSPITAL OPENS 1959 INTERN, RESIDENCY LIST

The dental and oral surgery service of the Mount Sinai Hospital in New York City is accepting applications for internships and residency for the calendar year beginning July 1959.

Since selections are generally made in December application should be made as soon as possible to Dr. Max Fuchs, assistant director, The Mount Sinai Hospital, 11 E. 100th St., New York 29.

### COURSES AT TORONTO LEAD TO SPECIALIST CERTIFICATION

The University of Toronto Faculty of Dentistry announces that applications will be received up to March 1 for enrollment in postgraduate courses leading to specialist certification in the fields of dental oral surgery and anesthesia, orthodontics, pedodontics and periodontics. Enrollment in each course is limited, and the courses extend over a period of two academic years (surgery, three years).

Applicants must present evidence of satisfactory completion of course leading to the D.D.S. degree or its equivalent from an acceptable dental school.

Further information and application forms should be requested from the Chairman, Division of Postgraduate Studies, Faculty of Dentistry, University of Toronto, 230 College St., Toronto, Ont., Canada.

### BIG TEACHER TRAINING GRANT MADE TO NEW YORK SCHOOL

A grant of $250,000 to support teacher training at New York University's College of Dentistry has been made to the college by the National Institute of Dental Research of the United States Public Health Service.

In announcing the five-year grant, Dean Raymond J. Nagle said the program is the first of its kind in the New York metropolitan area.

Eli D. Goldsmith, research coordinator and professor of histology at the college, will serve as training director of the graduate program.

Much of the grant has been allocated for scholarship stipends varying from $2,000 to $5,500 according to the needs and qualifications of applicants. Many stipends are immediately available; interested candidates can apply now and begin studying during the 1958-59 academic year.

Applications should be made to Dr. Goldsmith, New York University College of Dentistry, 421 First Ave., New York 10.

### CUMBERLAND HOSPITAL HAS ORAL SURGERY INTERNSHIP

The dental and oral surgery service of Cumberland Hospital in Brooklyn is accepting application for internships for the calendar year starting July 1959.

Applications may be secured by writing the medical superintendent, The City of New York Department of Hospitals, Cumberland Hospital, 39 Auburn Pl., Brooklyn 5, N. Y.

### ILLINOIS DENTISTRY COLLEGE HAS ORAL SURGERY COURSES

The College of Dentistry of the University of Illinois is accepting applications for two and three year full time courses in oral surgery beginning in September 1959. Both programs carry credit toward a master of science degree.

Further information can be obtained from Dr. Daniel M. Laskin, department of oral and maxillofacial surgery, University of Illinois, 808 S. Wood St., Chicago 12.

### REFRESHER AND POSTGRADUATE COURSES FOR WINTER, SPRING

*Alabama* • The University of Alabama School of Dentistry will present four refresher courses during the month of January. "The Recognition, Identification and Treatment of Oral Disease" will be given January 10-12 by Joseph L. Bernier; Adeeb E. Thomas will present a program on high speed technics January 16-18; Saul Schluger will instruct in a course on periodontology for the general practitioner January 24-26, and a course in oral roentgenology will be conducted January 30 through February 1 by Arthur H. Wuehrmann.

Three February courses are: "Dental Assisting" by Miss Gertrude M. Sinnett on February 14-15, a practical approach to the complete denture problem, given February 21-23 by Irving R. Hardy, and Samuel D. Gore presenting a program in removable orthodontic appliance construction February 28 through March 2. This last course is limited to practicing orthodontists.

Further information may be obtained by writing to: Director, Refresher Course Program, University of Alabama School of Dentistry, 1919 Seventh Ave., S., Birmingham, Ala.

*Albert Einstein Medical Center* • A course in dentistry for the handicapped child will be offered by Morris Kelner Tuesday and Wednesday, January 20-21, at the Northern Division of the Center. Registration, limited to 20 students, closes January 6. The fee is $75.

Application should be made to George I. Blumstein, M.D., Chairman, Subcommittee on Postgraduate Education, Albert Einstein Medical Center, York and Tabor Rds., Philadelphia 41.

*California* • Appearance and function in complete and partial prosthesis will be discussed by Earl Pound December 5-6. Tuition for the course is $50. Application may be made to Ben W. Pavone, Director, Postgraduate Education, University of California Medical Center, San Francisco 22.

*Columbia* • Joseph E. Johnson will direct a course in twin-wire appliance therapy December 8-12; the theory and practice of extra-oral forces will be conducted by James Jay March 16-21, and Clifford L. Whitman will direct a course in edgewise appliance therapy February 23-28.

Inquiries concerning these courses should be addressed to Joseph A. Cuttita, Chairman, Postgraduate Admissions, Columbia University School of Dental and Oral Surgery, 630 W. 168th St., New York 32.

*Loyola* • A postgraduate course in partial dentures will be given December 3-4 to a class limited to eight persons. The fee is $80.

Three courses have been scheduled for January. They are a workshop in preventive orthodontics January 29-31, an introduction

to high, super and ultra high speed dentistry January 7-14, and a workshop in preventive orthodontics January 29-31.

Application may be made to Loyola School of Dentistry, 1757 W. Harrison St., Chicago 12.

*Michael Reese* • A completely new course, "The Medical Laboratory in Clinical Dentistry," is being offered February 12-13 at the Michael Reese Hospital Medical Center by Emanuel Cheraskin and Arthur Elfenbaum.

Particulars may be obtained from the Dental Department, Michael Reese Hospital, 29th St. and Ellis Ave., Chicago 16.

*New York* • New York University's College of Dentistry, through its department of endodontics, will offer a 40-hour course beginning March 9 on new developments in the treatment of vital and nonvital teeth. The instructor will be Morris Auerbach.

Further information may be obtained from the Postgraduate Division, New York University College of Dentistry, 421 First Ave., New York 10.

*Northwestern* • Four courses for February are listed by Northwestern University Dental School. They are: basic oral surgery, February 2-6; newer concepts in periodontics, February 2-6; a practical approach to the use of gold foil, February 2-3, and endodontics, February 25-27.

Complete details and application forms may be obtained from Northwestern University Dental School, 311 E. Chicago Ave., Chicago 11.

*Ohio* • The Ohio State University College of Dentistry will offer a course in partial denture prosthodontics February 23-27 and one in pedodontics March 9-13. Enrollment in the first course is limited to ten and in the second to five students.

Further information may be obtained from the Postgraduate Division, College of Dentistry, Ohio State University, Columbus 10, Ohio.

*Pennsylvania* • Three postgraduate courses will be offered in January. Complete denture prosthesis will be presented January 12-15 by Vincent R. Trapozzano; John P. Looby will direct a course in hospital dentistry January 26-28, and Ernest R. Granger will conduct a course in prosthetic relations of the temporomandibular joint January 19-23.

Details may be had by writing to Postgraduate Courses, School of Dentistry, University of Pennsylvania, 4001 Spruce St., Philadelphia 4.

*Temple* • Closed circuit television and high speed equipment are features of several of the 21 postgraduate courses at Temple University School of Dentistry.

A course on the porcelain jacket is scheduled for November 6-8; fixed prosthesis, Wednesdays from January 7 through March 25; clinical oral pathology, January 15-17; advanced orthodontics, January 18-31, and advanced radiodontics, January 22-24.

Enrollment is limited for all courses listed. Further information may be obtained from Albert L. Borish, Graduate and Postgraduate Division, Temple University School of Dentistry, Broad above Allegheny Ave., Philadelphia 40.

*Toronto* • Enrollment is limited to 12 for a course in orthodontics for the general practitioner offered March 9-13 by the University of Toronto Faculty of Dentistry. The course is under the general direction of D. G. Woodside and the tuition fee is $100. The address is 230 College St., Toronto 2-B.

*Tufts* • Refresher courses open at Tufts University School of Dental Medicine include:

Occlusal equilibration, February 9-11; local anesthesia, February 9-11; orthodontic principles of interest to the general practitioner, Wednesdays from February 4 through March 25; cephalographics and diagnosis, January 14-16; crown and bridge prosthesis participation course, January 30, 31 and February 6, 7, 13, 14, 21, 28; and oral pathology for the oral surgeon, Thursdays from February 5 through April 2.

Details of courses and applications may be had by writing to Director, Division of Graduate and Postgraduate Studies, Tufts University School of Dental Medicine, 136 Harrison Ave., Boston.

*Virginia* • The School of Dentistry, Medical College of Virginia announces the following postgraduate courses:

Oral surgery, March 2-4; oral diagnosis, March 9-13; periodontology, March 16-18; anatomy of the head and neck, March 16-20, and dental roentgenography for auxiliary personnel, April 6-10.

Additional information can be obtained by writing to Dr. H. T. Knighton, Director of Postgraduate Instruction, Medical College of Virginia, Richmond, Va.

*Washington* • Two special courses in Decem-

ber have been announced by the University of Washington School of Dentistry.

Harry A. Young will conduct a course in complete denture prosthodontics December 1-6, and the principles of crown and bridge planning and fabrication will be taught by John D. Guthrie and Kenneth N. Morrison December 12-13.

Details may be procured by writing to the Department of Postgraduate Dental Education, University of Washington School of Dentistry, Seattle, Wash.

*Western Reserve* • A course in periodontal prosthesis will be given by Morton Amsterdam and Walter Cohen January 3-5, and a course in psychodynamics and practice administration by Lloyd Hollander and staff March 3-April 1.

Further information may be obtained from Philip Burwasser, Director of Postgraduate Education, Western Reserve University School of Dentistry, 2165 Adelbert Rd., Cleveland 6, Ohio.

# National Defense

### CHANGES IN MEDICARE ACT EFFECTIVE OCTOBER 1

Changes in the Medicare directive, which became effective October 1, have been spelled out by the Office for Dependents Medical Care and are of interest to all dentists.

The new regulations state that:

1. Outpatient treatment, that is, treatment in the doctor's office, for fractures, wounds, lacerations and other bodily injuries, will no longer be paid for by the government.

2. Payment for plannable dental surgery is no longer authorized. Payment will be made only for emergency surgery and acute medical conditions.

3. Except in legitimate emergency circumstances, dependents living with their military sponsors must use military facilities unless a permit is obtained from the post's commanding officer signifying that civilian care is authorized.

### RETIREMENT POINT CREDITS FOR RESERVE OFFICERS

Reserve dental officers of the Armed Forces who attend any three of six approved essay panel programs at the Association's annual session can earn three retirement credit points, according to Capt. H. J. Wunderlich, military general chairman.

Those essay programs of the scientific program approved by the Armed Forces for credit are:

Forum on periodontics in everyday practice.

Use and abuse of antibiotics and chemotherapeutic agents.

Forum on conservation of the dental pulp, Parts I and II.

Clinical evaluation of new high-speed equipment.

Methods of obtaining vertical dimension and centric relation.

### ARMED FORCES INSTITUTE OF PATHOLOGY SETS COURSES

The Oral Pathology Branch, Armed Forces Institute of Pathology, will present its annual course on pathology of the oral regions March 23-27, 1959. This course is open to both government and civilian dentists. Dentists in the federal establishment should apply through appropriate channels and civilians to the address at the end of this article. There is no tuition and applications should be made as soon as possible because of heavy registration. Information as to course content will be given in a later announcement.

The annual slide seminar conducted by the same branch will be held on May 22, 1959. Approximately 60 can be accommodated. A set of 25 slides together with a descriptive brochure will be given each one attending for his permanent possession.

This is a seminar on advanced oral pathology and the specific subject will be tumors of the maxillary and mandibular bones. Teachers and workers in oral pathology, oral diagnosis and oral medicine will be given preference on the registration. There is no charge for this seminar.

Information and registration forms for both events may be obtained from: Colonel Joseph L. Bernier, Chief, Oral Pathology Branch, Armed Forces Institute of Pathology, Washington 25, D.C.

### NAVY DEPARTMENT'S DENTAL PROCEDURES TOTAL 8 MILLION

Dental care was provided to Navy and Marine Corps personnel during the fiscal year ending in 1958 at 417 Navy dental facilities ashore and afloat throughout the world. In addition, dental care was provided to personnel in many areas of the United States where no permanent dental facilities are available, by dental officers attached to the Navy mobile dental units. Approximately eight million dental examinations, treatments and operations were accomplished in all branches of dentistry, except orthodontics, for military personnel and their dependents.

This was also the first fiscal year in which dependents outside the continental limits of the United States and at specifically designated "remote areas" within the continental limits of the United States received dental care under the Dependents Medical Care Act. During this period, some 330,000 dental procedures were accomplished for approximately 90,000 dependents.

*Subscripts* • On August 26 the name of the combined agencies FCDA and ODM was officially changed from Office of Defense and Civilian Mobilization to Office of Civil and Defense Mobilization. . . . According to the United Press, every Soviet citizen is being required, this year, to take a 22-hour training course in self protection. The entire population will be instructed in anti-aircraft, anti-atomic, anti-chemical and anti-bacteriological defense. . . . The A.D.A. Civil Defense Conference in Dallas November 8 will be followed by a conference session for the benefit of civil defense chairmen and all others who are interested in Emergency Medical Care Training for dental societies.

## General

### FOUR SECTIONAL COMMITTEES NAMED FOR DENTAL SURVEY

Four sectional committees to provide technical supervision for the comprehensive survey of dentistry being conducted by the American Council on Education have been announced by Byron S. Hollinshead, survey director. The appointments have been approved by the Commission for the Survey of Dentistry, headed by Dr. John Perkins, president of the University of Delaware.

Each committee will be concerned with one of the four broad areas into

which the study has been divided. The chairman and associate chairman, respectively, of the section on dental education are Harold J. Noyes, dean of the University of Oregon Dental School, and Raymond J. Nagle, dean of the New York University College of Dentistry.

For the section on dental research Thomas J. Hill of Brecksville, Ohio, chairman of the Association's Council on Dental Research, is chairman and Reidar F. Sognnaes, associate dean of the Harvard School of Dental Medicine, is associate chairman.

Jay H. Eshleman of Philadelphia, chairman of the Association's Council on Dental Health, is chairman of the section on dental practice, and Clarence R. Rutledge, Richmond, Calif., chairman of the Association's Judicial Council, is associate chairman.

The section on dental health is headed by Robert A. Downs, chief of the public health dentistry section of the Colorado Department of Public Health, as chairman and R. S. Poor, provost of the J. Hillis Miller Health Center at the University of Florida, as associate chairman.

### J. M. WISAN, PUBLIC HEALTH DENTISTRY FIGURE, DIES

Jacob M. Wisan, dental health director of the Philadelphia Health Department for the past five years, died October 4 in Philadelphia. At the time of his death, at 62, he was directing a research study in periodontal disease under a grant from the U. S. Public Health Service.

Dr. Wisan, widely known in the public health field, was director of dental health education for the American Dental Association in 1948 and had held several positions in the field of public dental health. He was chief of the Bureau of Dental Health of the New Jersey State Department of Health and director of the Joseph Samuels Dental Clinic at Rhode Island Hospital in Providence.

The author of many articles, Dr. Wisan was also co-editor of "Dentistry in Public Health," the standard text in its field.

A graduate of New York University College of Dentistry, Dr. Wisan received a master's degree in public health from Columbia University.

J. B. Wisan

### HELENA RUBINSTEIN EMPLOYES GET UNION DENTAL INSURANCE

Local 14-19 of the Oil, Chemical and Atomic Workers International Union, AFL-CIO, recently became the first industrial union to obtain nonprofit dental insurance for its members through collective bargaining with Helena Rubinstein, Inc.

Coverage will become effective November 1 through Group Health Dental Insurance, Inc. The plan provides that members may use their own dentists. It pays benefits to any dentist anywhere in the world.

Over 4,100 dentists in the New York metropolitan area are participating dentists of Group Health Dental Insurance and agree to accept GHDI allowances as full payment for subscribers whose annual family incomes are $5,000 or less. Subscribers who have family incomes of more than $5,000 pay the dentist the difference between the plan's allowances and the dentist's charges. Benefits are comprehensive and include the most frequently needed dental services.

### HOSPITAL INSTALLS DENTAL CENTER FOR HANDICAPPED

A dental center equipped to give complete dental care to handicapped patients has been established at the Children's Hospital in Baltimore. This is the first of its kind in the state of Maryland.

The unit will serve mentally or physically handicapped children or adults, according to its director, Burton R. Pollack, associate professor in physiology, Baltimore College of Dental Surgery, Dental School, University of Maryland.

The project reflects the aim of the Children's Hospital to expand its activities into various other needed fields, now that the Salk vaccine has cut the polio case load.

### DENTAL EDITORS TO DISCUSS EDITORIAL RESPONSIBILITIES

At the annual meeting of the American Association of Dental Editors November 8 in Dallas, a panel discussion of editorial and journalistic responsibilities will be moderated by Wesley J. Dunn, president. The meeting will be held in the Embassy West Ballroom of the Statler Hilton Hotel.

Bernard J. Conway, secretary of the A.D.A. Council on Legislation will speak on the legal aspects of publishing. The panel participants are William P. Schoen, editor of the *Journal of the Illinois State Dental Society;* Bruce L. Douglas, editor of the American Dental Society of Anesthesiology; Floyd D. Ostrander, vice-president of the A.A.D.E., and J. C. Almy Harding, chairman of the Council on Journalism.

### CHARLES I. TAGGART DIES IN BURLINGTON, VT.

Word has been received of the death September 30 in Burlington, Vt., of Charles I. Taggart, former Trustee of the American Dental Association. Dr. Taggart, who was 59 years old, served as Trustee of the First District from 1949 to 1955.

Dr. Taggart was a former president of the Vermont State Dental Society and of the Champlain Valley Dental Society. At the time of his death, he was chief of staff of dental service at two Burlington hospitals, Mary Fletcher and DeGoesbriand Memorial. He was graduated from Tufts College Dental School in 1928.

Dr. Taggart was the son of a dentist, the late Dr. J. E. Taggart, who also practiced in Burlington.

Charles Taggart

### DENTISTS AND PHARMACISTS FORM JOINT COMMITTEE

Gilbert L. Mellion, Rocky Hill, Conn., was elected chairman of the newly-formed Connecticut Joint Dental-Pharmaceutical Committee.

Function of the committee is to promote greater cooperation between the dental profession and the pharmacists who fill their prescriptions, thus providing better service to the patient.

### SCHEDULE FIRST LECTURE IN HONOR OF SAMUEL C. MILLER

The first Samuel Charles Miller Memorial Lecture will take place on Tuesday, February 10, 1959, at 8 P.M. in the new building of the New York University College of Dentistry located at 421 First Ave.

An invitation to all members of the dental profession to attend is extended by Sidney Sorrin, chairman.

### KENNETH COFIELD, FORMER ARMY LIAISON OFFICER, DIES

Word has been received by the Association of the recent death of Kenneth Cofield, formerly of New Castle, Ind., in New Orleans.

Dr. Cofield, 58, was liaison officer between the army surgeon-general's office and the American Dental Association during World War II, and also had been chief of the dental service of the 18th Army General Hospital at Myitkyina, Burma.

He was associated with the Veterans Administration in New Orleans at the time of his death.

### A.A.A.S. SETS SYMPOSIUM ON CALCIFICATION NEXT MONTH

A symposium on calcification in biologic systems will be conducted at the annual meeting of the American Association for the Advancement of Science next month.

The program has been arranged by Reidar Sognnaes and is sponsored by the American Dental Association, the American College of Dentists, the International Association of Dental Research and the medical and zoology sections of the A.A.A.S.

The three sessions of this symposium, presented by the Section on Dentistry, Nd, will be held at 8:30 A.M., 2 and 7 P.M., December 29, at the Shoreham Hotel in Washington, D. C.

### SIGMA EPSILON DELTA PLANS LUNCHEON MEETING AT DALLAS

A luncheon meeting in conjunction with the A.D.A. annual session in Dallas has been scheduled by Sigma Epsilon Delta fraternity for Monday, November 10, at the Statler Hilton Hotel.

All members wishing to attend may secure reservations by contacting Louis Abelson at the Statler Hilton Hotel or Al Ungar at the Hotel Baker Hospitality Room, both in Dallas.

*Also* • George C. Paffenbarger, senior research associate at the American Dental Association's Research Division at the National Bureau of Standards, received the 1958 Callahan Award at the 93rd annual meeting of the Ohio State Dental Association held last month in Cincinnati. . . . Sigma Epsilon Delta fraternity will hold its annual testimonial dinner in honor of Past Grand Master Sam Friedman Wednesday, December 10, at Cavanagh's, 260 W. 23rd St., New York City. All members interested in attending should contact Milton Bell, 154 Englewood Ave., West Englewood, N. J. . . . Stuart A. Narrod, A.D.A. research associate at the National Institute of Dental Research in Bethesda, Md., has resigned to accept a postgraduate Fellowship at Brandeis University where he will continue his study in biochemistry. . . . The Dental Alumni Society of the University of Pennsylvania will hold a social hour at the Greater New York Dental Meeting in the Gold Room of the Hotel Statler Wednesday, December 10, from 5 to 7 P.M. . . . Robert A. Downs, chief of the Public Health Dentistry Section, State Department of Public Health, Colorado, has been asked to be a member of an Advisory Committee for the revision of the 1946 Drinking Water Standards. The committee is to meet to complete recommendations for a new Drinking Water Standards document. . . . Mr. Robert E. Tumelty has been appointed director of Health Education Services for the California State Dental Association to succeed Mr. Wayne Jepson, who resigned to take a position at San Jose College. Mr. Tumelty began his new work October 1.

## A CASE OF EXTENSIVE ORAL REHABILITATION

*By J. B. Shaykin, D.D.S., Chicago*

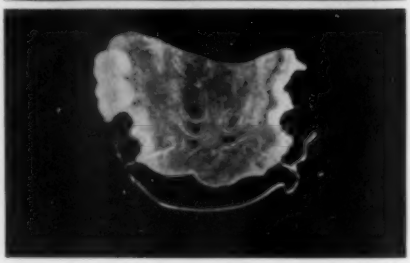
All too frequently middle-aged individuals suffer from a slow disintegration of their dental mechanism. Traumatic occlusion, caused by the extraction of some teeth, results in periodontitis augmented sometimes by periodontosis. One or more of the remaining posterior teeth may then be lost through extraction and others shift their position. The anterior teeth drift forward and assume an alarming inclination. In many instances of this kind extraction of the remaining teeth and the insertion of complete dentures seems to be the most practical solution.

In this instance the patient, a 45 year old man with a long history of periodontitis and an extreme dread of becoming edentulous, requested that his remaining teeth be saved if it were at all possible. Deep periodontal pockets were present around all the teeth. Several maxillary molar teeth were so loose as to be unsavable. The mucosa was deeply discolored and bleeding. The upper and lower anterior teeth had drifted forward so extensively that they had caused an unsightly protrusion of the lips. The interproximal spaces between the anterior teeth had become extremely wide and unbecoming.

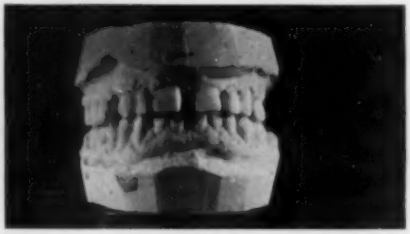
Despite the fact that the patient was advised that the prognosis was far from favorable and that restoration of the mouth would require a combination of oral surgery and periodontic, orthodontic and prosthodontic treatment, the reconstruction was undertaken. Following is a brief description of the various steps taken in the operation:

After the more seriously involved maxillary teeth were extracted—there were no such teeth in the mandible—the remaining teeth were carefully scaled and the mouth placed in as clean a condition as possible. (The first picture shows the patient's mouth before treatment was begun.)

Two removable acrylic resin orthodontic appliances were constructed which the patient wore for a period of four months. To move the teeth lingually the acrylic base of the appliances was relieved from time to time and labial pressure applied by adjustment of the labial wires.



The protrusion and interproximal spaces were reduced as much as possible and the extrusion of offending teeth relieved by grinding.

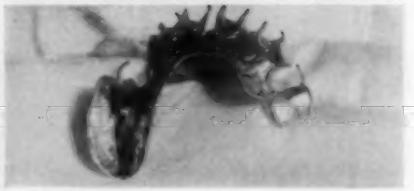


After the teeth were restored to as near normal position as possible, impressions of both arches were taken and the vertical relation established. Models were poured and mounted on a flat plane articulator. The bite was opened to allow free lateral excursions.

The mandibular appliance was waxed on the model.

The maxillary appliance was also waxed on the model.

The appliances were cast in Vitallium. Attention is called to the small labial prongs at the end of each clasp which act as permanent retainers.



These appliances were designed not only to replace the missing maxillary teeth but to accomplish the following:

1. Retain the remaining teeth in the position to which they had been restored by orthodontic procedures.

2. Eliminate pronounced overbite and maintain correct vertical dimension.

3. Balance the occlusion so that no pressure would be transmitted to the alveolar process and mucosa.

Since the insertion of these appliances, the patient has been able to masticate his food properly. His teeth have become firm in their sockets and his mucosa normally pink. He enjoys his improved oral and facial appearance and, above all, appreciates his ability to hold his pipe comfortably in place.

## CONCLUSION

This case required a judicious combination of periodontics, orthodontics, prosthodontics and oral surgery to regulate and stabilize the teeth, balance the occlusion, restore the soft tissues to normalcy, and change the temporomandibular joint relationship. The employment of these combined technics might well be termed dental orthopedics.

By correcting the position of the teeth, by retaining them firmly in position and by balancing the bite, the pressures that were destroying the bone and mucosa were relieved. With the etiological factors eliminated and the corrective appliances in place, natural forces readily came to the assistance of the patient and enabled him to enjoy a normal, efficient masticatory apparatus.

*25 East Washington St.*

## REMOVAL OF AN IMPACTED MAXILLARY CUSPID

*By Leonard McEvoy, D.D.S., Hollywood, Calif.*

The patient, a 41 year old man, was referred to me by his dentist in November 1955. His symptoms were a neuralgic type of pain at the side of the neck and face which radiated to the aural region. The upper cuspid on the right side was missing from the arch; all the other teeth were in position. There was neither intraoral nor extraoral swelling or inflammation. The patient's history otherwise was noncontributory and he was in good health.

*Roentgenographic Examination* • Roentgenograms made previously and sent by his dentist revealed a radiopacity above the bicuspid roots on the right side. Occlusal pictures (Fig. 1) disclosed an impacted cuspid high in the palate with the root lying laterally and the crown in the median line. No elevation of the palatal mucosa was evident.

*Operation* • Intravenous thiopental sodium was administered in the office. The palatal soft tissue was elevated from the necks of the teeth from the upper right first molar to the upper left cuspid. There was no evidence of the presence of the tooth on the underlying bone. By using a Henahan bone bur a window was cut over the region and the tooth exposed for about 1 cm. in the midline of the tooth. The halves were then separated by a bur and the two sections of the tooth removed. The root section presented difficulty because of a decided hook on the root end. The bone edges were smoothed with a file, and the cavity curetted. The palatal flap was returned to place and sutured interproximally with no. 000 silk. Upon recovery the patient was instructed to keep the flap as well adapted to the roof of the mouth as possible to prevent hematoma formation in the region and to insure healing by first intention.

*Postoperative Course* • The patient was given penicillin for four days. Healing was uneventful and the adaptation of the flap remained good. There was no breakdown of the clot during the healing process. The teeth on the upper right arch became sensitive to pressure for several days but the sensitivity subsided and reaction was negative thereafter. There was no change in vitality readings of these upper right teeth. The patient reported the neuralgic type of pains he had been experiencing were lessened after the operation. A

Fig. 1 • Occlusal view shows impacted cuspid with crown in median suture line

Fig. 2 • Occlusal view six months postoperatively. Area shows some regeneration of bone

postoperative roentgenogram taken six months later is shown in Figure 2.

*Comment* • Access to this region appears to be obtained better by a complete palatal flap than by incisions in the mucosa. The appearance of the healed region discloses no recession from the necks of the teeth and since the method gives better access it would seem to be the procedure of choice. The author has never seen a patient experience excessive bleeding on elevating the incisal papilla. This is probably due to the fact that the sphenopalatine artery does not course through this structure, and the terminal vessels from the descending palatine artery are so small that they present no particular problem. Treating the patient with antibiotics for several days is of great importance in the healing process.

*6381 Hollywood Blvd.*

***Experience*** • Without fullness of experience, length of time is nothing. When fullness of life has been achieved, shortness of life is nothing. That is perhaps why the young have usually so little to fear of death; they live by intensities that the elderly have forgotten. *Lewis Mumford.*

# *Book Reviews*

## MEDIZINISCHE RÖNTGENTECHNIK. LEHRBUCH FÜR MEDIZINISCH-TECHNISCHE ASSISTENTINNEN, ÄRZTE UND STUDIERENDE. I. MEDIZINISCHER TEIL. SKELETTAUF-NAHMEN UND ORGANUNTERSUCHUNGEN. (MEDICAL ROENTGEN TECHNIC. TEXTBOOK FOR MEDICAL TECHNICAL ASSISTANTS, PHYSICIANS AND STUDENTS. I. MEDICAL VOLUME. STUDIES OF SKELETON AND ORGANS)

*By Prof. Dr. Herbert Schoen. Second edition. 347 pages with 537 illustrations. D.M. 29.70. Stuttgart, Georg Thieme, 1956.*

The first edition of this book (1951) was intended for the use of medical assistants. It was so well received, both by technical personnel and their physician-employers that the author, in this second edition, has expanded those portions which concern chiefly the radiologist. Many newly-developed technics have been added. There is a new chapter on the diagnosis of soft parts, the section on vasography is enlarged, and the chapter on pneumoradiography now includes technics of intraperitoneal and retroperitoneal gas insufflation.

A general introduction to materials and methods is followed by major chapters on skeleton, teeth and joints which, collectively, comprise over one half the book. Also considered are soft parts, vasography, nasopharynx and larynx, heart, lungs, digestive and urinary systems, male genitalia, obstetrics and gynecology, fistulas, myelography, encephalography, ventriculography, pneumoradiography and localization of foreign bodies.

Most of the illustrations are excellent, fine-screen half-tone plates, grouped to show, on one page, the patient and apparatus, skeletal parts, and roentgenogram. Often there is an accompanying explanatory sketch or tracing. The quantity and detail of the illustrations obviate a lengthy accompanying text. Much of the latter consists of a simple listing of pertinent data on film, positioning, and so forth. These factors, plus the similarity of the technical terminology in German and English, and wide use of Latinized anatomical terms should allay any apprehension of the reader regarding possible difficulties in handling the German text. An index, as such, is lacking, but the detailed "Inhaltsverzeichnis" (Table of Contents) and its complete set of page references serve as a substitute.

*Vernon E. Krahl*

## ERGEBNISSE DER MEDIZINISCHEN GRUNDLAGENFORSCHUNG (CONTRIBUTIONS TO MEDICAL BASIC RESEARCH)

*Edited by K. F. Bauer. 855 pages with 217 illustrations. Index. DM. 129. Stuttgart, Georg Thieme, 1956.*

Although this book is intended primarily for physicians it contains much information of value to dentists. Until this work appeared there existed no modern German reference book on basic medical research.

The editor was able to assemble a distinguished group of scientists from England, France, Japan, Sweden, Switzerland, the United States and Germany to contribute papers on the research work in various fields, carried out in different countries.

Among others, subjects such as the following are covered: mitochondrias (Glimstedt and Lagerstedt); minute structures of nuclei and cytoplasms in their relation to cell function (Lehmann); metabolites and antimetabolites (Somogyi); kinetics and thermodynamics of the enzymic reactions of living cells and tissues (Holzer); vitamin research from 1950 to 1954 (Stepp); elementary processes in muscle contraction (Fleckenstein); recent research on allergy (Scheiffarth); hypothermia (Laborit), and embryology in pathologic research (Töndury).

Of particular interest is the arrangement of tests according to disease or organs involved, especially since adequate interpretation follows each research procedure. Although the work was published in Germany, and the majority of the contributors are Europeans, it contains many references to American and English literature.

The book, excellently printed, illustrated and bound, can be highly recommended to dental practitioners, students and researchers, who are able to master the sometimes difficult to understand, scientific German language used throughout the book.

*Paul H. Glucksman*

## ILLUSTRATIVE MODEL PROJECTION OF DENTIST POPULATION: A PRELIMINARY STUDY IN THE STATE OF TEXAS

*By Richard C. Henshaw, Ph.D., and Melvin A. Casberg, M.D. 40 pages with 20 tables. Austin, Texas, The University of Texas, 1957.*

This study is an endeavor to predict future population-dentist ratios in the State of Texas. It is an actuarial study in which 1949-1951 death rates of white males, and estimated retirement rates, are applied to the Texas dentist population. Assumptions are made regarding the size of graduating classes of Texas dental schools, the net gain through state-to-state migration of dentists and the net loss of Texas dentists to the Armed Forces. Population projections used were those made by the Texas Research League, which indicate a population of 12.1 million in Texas by 1975.

The study assumes no increase in the number of graduates of Texas dental schools after 1961. The study indicates that the supply of dentists in Texas will improve each year from 1955 through 1975; that is, the population per dentist will decline. Other regional and national studies of this type have generally indicated the opposite: the population per dentist will increase unless there is a substantial increase in size of graduating classes. The apparent reason for the difference is that the number of graduates of Texas dental schools will increase sharply from 104 in 1958 to 155 in 1961, at which time Texas dental schools will account for about 4.6 per cent of the national total of dental graduates, whereas currently only about 3 per cent of the nation's dentists are in Texas.

*B. Duane Moen*

## INJURIES OF THE BONES OF THE HEAD: AN ATLAS OF CLINICAL AND X-RAY DIAGNOSIS

*By J. Vondra, M.C. and R. Blaha, M.D., University Hospital of Prague. 308 pages with 170 illustrations. Prague, Czechoslovakia, Artia, 1956.*

Injuries of the bones of the head and face are of concern to all in the health field. Recognizing clinical symptoms as well as the information revealed in the roentgenograms is important. The authors are to be commended on the terminology.

The value of this volume to the general and plastic surgeon is understood. However, using these images for diagnostic purposes has a disadvantage since the prints are negatives and we are in the habit of reading positives. Landmarks are not readily recognized and this applies to fractures as well as to pathologic regions. This practically nullifies the value of the volume in dentistry.

Very little is said about the value of stereoscopy in fractures of the skull but of course this could not be demonstrated satisfactorily on the printed page. Tomographic examination is mentioned in favorable light and the authors are to be commended in this and in using the Latin nomenclature.

*Lee Roy Main*

## TISSUE CHANGES IN THE DENTAL PULP: AN EXPERIMENTAL HISTOLOGIC STUDY

*By Kaare Langeland, Ph.D. 212 pages with 63 illustrations and conclusions also in French. $7. Oslo, Norway, Oslo University Press, 1957.*

This work reflects the usual excellence of a doctor's thesis in the Scandinavian countries. It was done at the Norwegian Institute of Dental Research. The book deals primarily with the influence of cavity preparation and filling materials on the pulp. Dr. Langeland used human material throughout. He reviewed the literature thoroughly, designed the investigations with adequate controls, and experimented with the effect of histologic technic on the occurrence of the criteria commonly used to judge pathology in the pulp.

The criteria of pulp pathology reviewed and investigated included the eosinophilic zone, staining ability of the predentin, vacuoles, nucleoli in the odontoblast nuclei, capillaries in the odontoblastic layer, erythrocytes and brown pigment, erythrocytes and nucleus-like bodies in the dentinal tubules, inflammatory cells and calcifications. Many of these deviations from the "normal" pulp were observed in clinically intact teeth.

Pulp reactions to caries, to cavity preparation with rotary speeds up to 50,000 rpm, to dry and wet cavity preparation, to treatment of cavity subsequent to preparation, and to various filling materials were evaluated in a critical manner. This is reflected by a number of the chapter headings: "The reconnaissance of hemorrhage with special regard to the dental pulp; the significance of the migration of odontoblast nuclei into the dentinal tubules"; "Investigations on the formation of giant cells in the pulp"; and "Regeneration and repair."

This reviewer especially enjoyed Chapter VII, "Carious dentin in experimental cavities," in which the author attempted to initiate caries in clinically intact teeth by in-

serting carious dentin into experimental cavities. Caries were not produced, but the author did gain important information about the formation of secondary dentin.

The investigation involved 213 instances, which fact, together with the excellent experimental design and meticulous attention to important details, makes it authoritative. *Tissue Changes in the Pulp* should be read and studied by every teacher of operative dentistry and dental histology.

*George C. Paffenbarger*

EMPLOYMENT OUTLOOK IN HEALTH SERVICE OCCUPATIONS

*By the U. S. Department of Labor, Bureau of Labor Statistics in cooperation with the Veteran's Administration. First edition. Reprinted from the Occupational Outlook Handbook 1957 Edition.) 39 pages with 9 illustrations. Index. 35 cents. Washington 25, D. C., Superintendent of Documents, 1958.*

A recent and widely publicized Kiplinger report has stressed that career horizons in any one of the many health service occupations of the nation will continue bright and promising for our young people for at least another decade, and possibly two. This reprint from the *Occupational Outlook Handbook 1957 Edition* will lend considerable weight to the Kiplinger prophecy in presenting carefully prepared occupational briefs for 15 occupations in which well over one and a quarter million persons are employed. Each occupation is described within a general format which includes: the nature of services performed; areas of major employment; training and other requirements for practice; employment outlook; earning ranges and working conditions, and supplementary information sources.

In the two career sketches relating to dentistry and dental hygiene, the data is both current and accurate and in both instances satisfactorily supplements similar publications produced by each association. In view of this excellent coverage of the dental and dental hygiene professions, one hopes that next year's edition of *Employment Outlook in the Health Service Occupations* will also give attention to two auxiliary occupations in dentistry which are not covered in the 1957 edition of the pamphlet; namely, dental laboratory technology and dental assisting. Recent developments in both of these auxiliary fields have been significant and each of these occupations merits inclusion in the subsequent editions of this ably prepared reference book.

*B. F. Miller*

A MANUAL OF DENTAL ANESTHESIA

*By W. Harry Archer, D.D.S. Second edition. 336 pages with 174 illustrations. Index. $8.50. Philadelphia, W. B. Saunders Co., 1958.*

The purpose of this book is to provide a practical manual on both local and general anesthesia for the dental student and practitioner. Actual technics, proved successful in the vast experience of the author, are described with simplicity in a text well-documented with many fine illustrations. The pharmacology of the drugs employed, so basic to the subject of anesthesia, is concisely but adequately treated.

This second edition contains essentially the same material as the first edition published in 1952 with some notable additions. An excellent chapter on endotracheal anesthesia and intubation and a worthwhile chapter on preoperative recognition and treatment of bronchopulmonary disease have been added. The chapter on general anesthesia for oral surgery in the hospital has been elaborated upon. Descriptions have been included for trichloroethylene-nitrous oxide-oxygen administration and for the relatively new technic of chemanesia combined with analgesia for the ambulatory dental patient. A discussion of vasoconstrictors in local anesthesia and their use in patients with heart disease has also been included.

This treatise is readily recommended for all professional persons interested in dental anesthesia.

*James Springer*

ORAL SURGERY

*By Kurt H. Thoma, D.M.D. Third edition. 1,567 pages with 1,824 illustrations (159 in color). Index. $27.50. St. Louis, C. V. Mosby Co., 1958.*

This is the third edition of Thoma's classic work. The broad scope and magnitude of this treatise reflect the high levels already achieved by the specialty of oral surgery. But further, the text is a comprehensive chronicle of the dynamic growth and progress continually taking place within this discipline of dentistry today, faithfully recorded and interpreted with perspective and critical integrity by one of our most creative and authoritative spokesmen.

Both the first (1948) and second (1952) editions were printed in two volumes. The current edition, however, is composed of a single impressive volume which makes for more convenient readability in general. New ideas and improved methods and technics

have been incorporated into many of the chapters; for example, a description of the latest drugs used for administration of local and general anesthesia ("Anesthesiology") and a discussion of denture implants ("Treatment of Abnormalities of the Edentulous Mouth"). Many previous case reports have been either shortened or eliminated.

Three entirely new and important chapters have been added; namely, "Roentgen Examination of the Face and Jaws"; "Pharmacology" and "Surgical Eruption and Positioning, Transplantation and Replantation of Teeth."

Thoma's labor of love has been considered an indispensable reference work for dental students and members of the dental and medical professions by the distinguished author's legion of admirers at home and abroad ever since its original publication ten years ago. By the same virtue, the present edition may be enthusiastically endorsed for the library of every individual interested in keeping abreast of developments within the field of oral surgery today.

*James Springer*

## WÖRTERBUCH DER KLINISCHEN SYNDROME (VOCABULARY OF CLINICAL SYNDROMES)

*By Bernfried Leiber, M.D. and Gertrud Olbrich, M.D. 558 pages with 96 illustrations. Index. DM. 49. Munich, Urban & Schwarzenberg, 1957.*

A dental or medical terminology is unthinkable without the inclusion of modern terms of sets of symptoms occurring simultaneously (syndromes) and the names of persons who were the discoverer or inventors of such symptom complexes (eponyms).

As George B. Denton, in his work *The Vocabulary of Dentistry and Oral Science*, A.D.A., 1958, pointed out, there are several objections to eponymic terms. "There is frequently uncertainty as to who was the discoverer, inventor or most important contributor to the entity designated. An eponym furnishes no descriptive information with regard to the concept. Eponyms usually have little versatility; that is, they do not enter into combinations easily and cannot be converted into other parts of speech." In some instances, however, a disease or its syndrome may be recognized as an entity before its nature is sufficiently well defined to permit selection of an accurately descriptive term. All dental and medical vocabularies, therefore, have to deal with eponyms.

Because of the considerable confusion and overlapping in the nomenclature of syndromes, the authors suggest that the users of the book select the first term of each group of the numerical list for diagnosis. This term, whether eponymic or descriptive, is the preferred diagnostic term. Only these preferred terms have been listed in the body of this vocabulary; eponyms and synonyms appear in the indexes.

The main purpose of this vocabulary is to attempt to overcome barriers to international communication that presently exist in terminology of syndromes and coding systems. In spite of the remaining complexities of syndrome terminology, this work provides a valuable contribution toward more accurate analysis, diagnosis and exchange of information. The main drawback in listing all important terms designating syndromes with their etymology, definition, data and explanation is that it is written in scientific German, and it requires far more than a superficial knowledge of this language to make efficient use of this work.

The book, excellently bound, printed and illustrated, is stimulating and interesting and contains a wealth of material. Although American readers may differ with some points of view, nevertheless, they are points of view that are current in Europe and should be known in this country, even though they might not be acceptable to American dentistry or medicine.

*Paul H. Glucksman*

## FULL DENTURES

*By Chester Landy, D.M.D. 182 pages with 82 illustrations. Index. $5.85. St. Louis, C. V. Mosby Co., 1958.*

The textbook on complete denture construction is designed for the busy practitioner and for postgraduate lectures. This book was written to bridge the gap between the exhaustive textbook and the short scientific article.

The material covered is well organized, and the subject matter is adequately handled. One specific technic for complete denture construction is given along with comments on other technics.

The author has included a short chapter on drugs, and occasionally makes reference to the use and value of medicine as an adjunct to complete denture construction.

The paper and binding of the book are of good quality and the author's style of writing makes the text easy to read.

*Joe P. Lambert*

# *Current Literature*

## DENTAL MANPOWER AND THE PUBLIC'S HEALTH: THE ROLE OF THE STATE HEALTH AGENCY

*Wesley O. Young. Am. J. Pub. Health 48:46 Jan. 1958.*

The basic objective of any public dental health program is to improve the oral health of the public through organized community activities. With the exception of water fluoridation, all other effective methods for improvement in dental health depend on the availability of trained dental personnel, the supply of which is inadequate at the present time. The responsibility for providing an adequate supply of dental personnel rests with the state health agency, the educational institutions, the state administration and legislature, the dental profession and the public. An example of the role played by state health agencies to solve manpower shortages is demonstrated in the study of manpower requirements in the 11 western states, Alaska and Hawaii recently published by the Western Interstate Commission for Higher Education. The application of this type of study by state agencies to their own state can act as an effective guide to future requirements in dental personnel.

Future dental students of New Mexico may be absorbed in a new dental school in Colorado and a plan to inaugurate a curriculum for dental hygienists is being considered by the University of New Mexico. Preliminary studies conducted by the State Health Department of the Rocky Mountain area has confirmed the desirability of establishing a dental school at the University of Colorado. As a result of investigation conducted by the State Health Department of Idaho, an appropriation was secured from the state legislature to send students to dental schools in other states. Similarly scholarships for dental hygiene students have been instituted in order to increase the supply, and consideration is being given to the establishment of a school for dental hygienists within that state.

Four basic steps are involved in providing adequate supplies of dental personnel.

1. Determining the present and future manpower needs and the supply available to meet these needs.

2. Where the supply is inadequate, appropriate agencies working together to organize new facilities or expand existing ones.

3. Planning for the maximum utilization of existing or contemplated educational facilities both to meet the needs of the state and to solve regional problems.

4. Promoting an equitable distribution of dental personnel.

The function of the state dental division in the performance of these activities is to stimulate interest and action, to coordinate joint action and to serve as a source of technical information.

*Gilbert I. Brinsden*

## FUNCTIONAL ORAL PROSTHESIS

*Daniel Isaacson. J. New Jersey D. Soc. 29:14 Jan. 1958.*

Two main philosophies are incorporated into every situation where a patient requires full mouth restorations: the periodontal idea of cure and the gnathological principle of full cusped articulation in harmony with jaw movements.

Indications for complete treatment include unesthetic conditions, presence of periodontal disease and teeth requiring splinting or recontouring of occlusal or gingival surfaces, easing of temporomandibular joint disturbances of a functional nature, and presence of extensive dental carious lesions which require more than conventional restorations.

The therapeutic program is divided into two phases; the preliminary phase, including oral surgery, endodontics, periodontics and orthodontics, and the restorative phase, which includes jaw movement registration, preparation of teeth, laboratory and mechanical work, and completion of the prosthesis.

Temporary acrylic splints are utilized over roughly prepared teeth where anterior teeth must be extracted or where periodontal splints are required.

Nonvital abutments with posts, if necessary, are used unhesitatingly after modern endodontic treatment. Final preparation of the teeth is not done until periodontal treatment is complete and gingival margins are stable.

After periodontal therapy, cautious orthodontic treatment is used to move teeth into proper position for final restorative procedures. All orthodontic treatment should be done after periodontal therapy, unless a tooth must be straightened before placing a periodontal splint.

Once preliminary procedures are completed, accurate jaw registrations are made with a gnathograph. Teeth with crowns that have been extensively destroyed by caries are prepared for full crown restorations. A face-bow and centric registration are then made. Casts and dies are mounted on a fully adjustable articulator and the prosthesis is constructed; strict attention is paid to proper articulation and contact in all jaw movements. The castings are returned to the mouth and any discrepancies are corrected. At this point, a new face-bow and centric registration are made along with new upper and lower impressions.

Casts are remounted and errors in articulation corrected. The prosthesis is completed on the articulator and returned to the mouth for temporary cementing. After making certain that the articulation has been oriented correctly to the patient's jaw, and the periodontal tissues show signs of healing, the prosthesis may be cemented permanently.

*Roland Diodati*

## CEPHALOMETRIC ROENTGENOGRAPHY OF INFANTS: SEDATION, INSTRUMENTATION AND RESEARCH

*Samuel Pruzansky. Am.J.Orthodont. 44: 159 March 1958.*

It is a well-established fact that the greatest increments in postnatal growth of the head in man occur during the first year of life. Despite the increasing interest in cephalometric roentgenology as a means of measuring growth of the head, comparatively little information has emerged regarding the patterns of normal and abnormal growth of the face and cranium during this period of most prolific growth.

Cephalometric roentgenography of infants and small children has been made possible through the use of sedation and the design of cephalometric apparatus specifically suited to the handling of infants.

The cephalometric equipment was designed to conform with the Broadbent-Bolton standards.

It was found that rest position of the mandible, as recorded in the sedated infant, was remarkably constant for that infant. The same mandibular posture was obtained at a later age in the same child when similar examinations were performed without sedation and with the child in the supine position on the cephalometer for infants. Similar rest positions for the mandible in the same child were registered when lateral headplates were finally obtained with the child sitting in the Broadbent-Bolton cephalometer. The primary requirement for such regularity of mandibular posture was the maintenance of similar head to neck to body relationships.

Serial investigations of a variety of congenital deformities of the brain case and facial skeleton were presented to demonstrate the value of these technics in the study of abnormal patterns of growth of the head in infants and small children.

*William F. Ford*

## THE MANDIBULAR THIRD MOLAR AS A PARTIAL DENTURE ABUTMENT

*Lawrence A. Weinberg. New York State D. J. 24:127 March 1958.*

The preparation of rest seats perpendicular to the long axis of abutment teeth directs the vertical occlusal force along the long axis of tilted teeth. This allows a decrease in the mesial torque transmitted through the rest to the mesially tipped lower third molar.

To reduce lateral stress when a lingual axial inclination as well as a mesial inclination exists, the rest seat is placed buccolingually so the occlusal rest, crest of the ridge and the pontic are in a relatively straight line.

Reduction of a deep mesial undercut is advocated by recontouring with a gold restoration. In restoring the occlusal surface, the occlusal table is narrowed but is not built up to the occlusal plane of the saddle.

*Carl P. Regli*

## THE UPTAKE, EXCHANGE, AND RELEASE OF FLUORIDES AT THE SURFACES OF THE TEETH. REPORT OF PRELIMINARY INVESTIGATIONS USING THE RADIOACTIVE ISOTOPE $F^{18}$

*L. L. Hardwick, J. H. Fremlin, and J. Mathieson. Brit. D. J. 104:47 Jan. 21, 1958.*

There is as yet no definite information as to whether the local concentration of fluoride at the site of a carious lesion can be high enough to inhibit action of the enolases of bacteria, and thus prevent progress of caries. A research program to investigate this is under way. It will involve the use of $F^{18}$ whose short half-life presents problems not found in isotopes with longer half-lives. The isotope must be handled in polythene apparatus to prevent loss by adsorption, and special methods of preparing tooth sections and making radioautographs must be used. These methods will make it possible to determine concentrations of fluoride in the tooth and under a plaque.

*Henry M. Leicester*

COUNCIL ON DENTAL THERAPEUTICS

# Tests and assays for Accepted Dental Remedies

*Edward G. Feldmann, Ph.D., Chicago*

As one of its several research programs, the Division of Chemistry of the Council on Dental Therapeutics develops pharmaceutical standards for drugs of interest in dentistry. Descriptive monographs are published in *Drug Standards,* one of the journals of the American Pharmaceutical Association. They describe appropriate chemical and physical tests and assay procedures which may be employed in any suitable laboratory to identify the drug and to determine its purity and concentration. The monographs include separate sections which relate individually to the basic drug and to its various dosage forms. Tolerance limits are established for those drugs and their commercially available dosage forms which have been accepted for listing in *Accepted Dental Remedies.* The tolerances, data, and procedures provided in these reports are not to be construed as being official specifications since they are not enforced by government agencies. The monographs are designed, however, to provide a set of definite chemical and pharmaceutical standards for drugs appearing in *Accepted Dental Remedies,* and to furnish the pharmaceutical chemist and other interested individuals with the chemical information needed to identify and determine the particular compound. These specifications serve to assure the dentist further that Council accepted products are of proper potency and of the highest purity which good pharmaceutical manufacturing processes will allow.

In order to avoid unnecessary duplication, monographs are developed by the Division only for those drugs which have not been investigated by the Chemical Laboratory of the American Medical Association, or for which suitable identification tests and assay procedures are not available in the *United States Pharmacopeia* or *National Formulary.* The titles of these monographs are listed periodically in THE JOURNAL so that interested members of the dental profession may note their availability in the literature.

## RECENT MONOGRAPHS

Levo-nordefrin, tests and assays for. Drug Standards 26:145 July-Aug. 1958.

Meprylcaine hydrochloride, tests and assays for. Drug Standards 25:130 July-Aug. 1957.

Metabutethamine hydrochloride, tests and assays for. Drug Standards 25:128 July-Aug. 1957.

Metabutoxycaine hydrochloride, tests and assays for. Drug Standards 26:147 July-Aug. 1958.

Propoxycaine hydrochloride, tests and assays for. Drug Standards 26:148 July-Aug. 1958.

Director, Division of Chemistry, Council on Dental Therapeutics.

# Council announces classification of additional products

The classification of products by the Council on Dental Therapeutics has been described in a previous report (J.A.D.A. 40:489 April 1950). The Council's program now provides for classification of products in Group A, Group B, Group C and Group D. Products are reconsidered periodically, and decisions are subject to change at any time that a substantial amount of new evidence becomes available. The files of the Council contain information on many drugs and dental cosmetics, and inquiries are welcome.

## GROUP A

Listing of products in Group A means that at the time of their consideration, the items conformed with the provisions for acceptance established by the Council on Dental Therapeutics and adopted by the Board of Trustees and the House of Delegates of the American Dental Association. Items in this group will be listed in *Accepted Dental Remedies*, and may use the Seal of Acceptance, unless otherwise provided.

The following additional products are classified in Group A:

**Procaine HCl, U.S.P.** (See A.D.R. 1958, p. 23), Epinephrine U.S.P. (See A.D.R. 1958, p. 117).

*Procaine HCl 2% Epinephrine 1:50,000* (Graham Chemical Corporation): (See A.D.R. 1958, p. 34) Manufactured for the following distributor:

Park-Woods Company

*Procaine HCl 4%, Epinephrine 1:65,000* (Graham Chemical Corporation): (See A.D.R. 1958, p. 34) Manufactured for the following distributor:

Park-Woods Company

**Procaine HCl, U.S.P.** (See A.D.R. 1958, p. 23), **Phenylephrine HCl, U.S.P.** (See A.D.R. 1958, p. 119)

*Procaine HCl 4%, Phenylephrine HCl 1:2,500* (Graham Chemical Corporation): Manufactured for the following distributor:

Park-Woods Company

**Procaine HCl, U.S.P.** (See A.D.R. 1958, p. 23), **Tetracaine HCl, U.S.P.** (See A.D.R. 1958, p. 27), **Phenylephrine HCl, U.S.P.** (See A.D.R. 1958, p. 119).

*Procaine HCl 2%, Tetracaine HCl 0.15%, Phenylephrine HCl 1:2,500* (Graham Chemical Corporation): Manufactured for the following distributor:

Park-Woods Company

**Procaine HCl, U.S.P.** (See A.D.R. 1958, p. 23), **Tetracaine HCl, U.S.P.** (See A.D.R. 1958, p. 27), **Levo-nordefrin** (See A.D.R. 1958, p. 118).

*Novocain 2%, Pontocaine HCl 0.15%, Neo-Cobefrin 1:20,000* (Cook-Waite Laboratories, Inc.): Each ml. is stated to contain procaine HCl, 0.02 Gm.; tetracaine HCl, 0.0015 Gm.; levo-nordefrin, 0.0005 Gm.; acetone sodium bisulfite, not more than 0.002 Gm.; sodium chloride, 0.004 Gm.; and water for injection. Marketed in 2.2 ml. cartridges.

**Meperidine HCl** (See A.D.R. 1958, p. 50)

*Demerol Hydrochloride* (Winthrop Laboratories Division of Sterling Drugs, Inc.) A brand of meperidine HCl.

*Demerol Hydrochloride Tablets, 50 mg., 100 mg.:* Stated to contain meperidine HCl and excipients.

*Demerol Hydrochloride Sterile Aqueous Solution 5 per cent:* Each ml. is stated to contain meperidine HCl, 50 mg., in water for injection. Marketed in 1 ml., 1.5 ml. and 2 ml. ampuls.

*Demerol Hydrochloride with Atropine Sulfate Sterile Aqueous Solution:* Each 2 ml. is stated to contain meperidine HCl,

100 mg.; atropine sulfate, 0.4 mg., and water for injection. Marketed in 2 ml. ampuls.

GROUP B

Listing of products in Group B means that there is insufficient evidence to justify their present acceptance, but there is reasonable evidence of their usefulness and safety. These products meet the other qualifications and standards established by the Council on Dental Therapeutics. It is the Council's opinion that Group B products may be promoted for special use and study.

The Council's initial consideration of products which may be eligible for Group B listing is influenced favorably by the knowledge of further investigations then in progress. It is the policy of the Council to reconsider Group B products each year on the basis of new evidence which may be produced in their support. Classification in this category is not ordinarily continued for more than three years.

GROUP C

Listing of products in Group C means that the evidence is so limited or inconclusive that the products cannot be accurately evaluated. It is the Council's opinion that Group C products require further study by qualified investigators.

GROUP D

Listing of products in Group D means that they are unacceptable because of their demonstrated inability to meet the standards outlined in the provisions for acceptance.

BUREAU OF DENTAL HEALTH EDUCATION

## Special aids for centennial year celebration of National Children's Dental Health Week

For National Children's Dental Health Week in the centennial year, the Bureau of Dental Health Education has produced special aids to be used by the local dental societies.

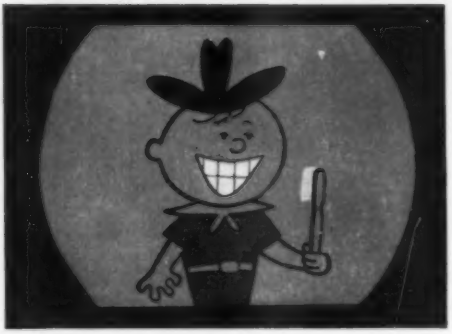
These are a set of five 20 second 16 mm. television spot announcements, three radio transcriptions, professionally written television and radio scripts, outdoor advertising posters, and miniatures of the 1959 dental health week posters.

The TV announcements are clever, animated spots that will catch the viewer's eye. Subjects are deciduous teeth, brushing teeth, early dental care, keeping one's teeth for a lifetime and sweets and tooth decay. Only one set of the spots can be sent to a dental society—as long as the supply of 200 lasts. The society may keep the films on a permanent loan basis.

The 15 minute transcriptions are instructive in an entertaining way. One concerns toothbrushing—with a look to the past that shows toothbrushes are not a recent invention. The second relates the dramatic story of the research that showed the value of fluorides in developing decay-resistant teeth. The third tells how two dentists—Dr. Wells and Dr. Morton—discovered the use of nitrous oxide and ether as anesthetics and thus fundamentally changed the practice of dentistry and of medicine and surgery.

These transcriptions may be sent on a free loan basis to any society which can be assured that they will be played on its local radio station. They should be returned postpaid to the Film Library of the American Dental Association. The 100 sets of transcriptions will be lent to the first 100 dental societies requesting

SPECIAL AIDS
FOR DENTAL SOCIETIES



NATIONAL CHILDREN'S DENTAL
HEALTH WEEK

UNLOCK YOUR SMILE
It's the brushing that counts
11th NATIONAL CHILDREN'S DENTAL HEALTH WEEK · FEB. 8-14
AMERICAN DENTAL ASSOCIATION CENTENNIAL 1859 • 1959

them. The recordings may be used on only one station and played only once in any community. However, they may be used without restriction for schools, service clubs, P.T.A.'s and similar groups.

Two television and four radio scripts, plus 15 and 30 second radio spot announcements, are included in this year's packet of planning suggestions for dental health week. Additional copies of all are available on request; flip cards and a photograph needed as a prop will be included when extra copies of the TV scripts are sent. These scripts and one radio script are 15 minutes; a second radio script is 5 minutes, and two are 4:40 minutes.

With the exception of the five minute talk for women's program directors, all of this year's TV and radio scripts bring in children or adults in addition to dentists. It is hoped that this will be a means of widening interest in the programs.

Miniatures (3 by 4 inches) of the 1959 NCDHW poster have been printed with a dental health message on the back. They can be enclosed in monthly statements or handed out to school children. Prices are: (100-900) $0.50 per 100; (1,000-9,000) $4.00 per 1,000; (10,000 and up) $3.50 per 1,000.

A 24-sheet outdoor advertising poster, 104 inches high and 234 inches wide, is available for $6. If local or state outdoor advertising companies are asked early, they may be willing to provide free space for the posters. The posters will be effective public relations material for both dental health week and the centennial.

With the exception of the miniature posters and the outdoor advertising posters, there is no charge for any of these special aids. Full information concerning these materials will be found in the National Children's Dental Health Week planning packets. These packets are being distributed by the Bureau of Dental Health Education in the various states according to instructions from the state chairmen for NCDHW.

COUNCIL ON DENTAL RESEARCH

## Supplement to List of Certified Dental Materials

DELETION • The American Dental Association Research Division, National Bureau of Standards, has been advised by the manufacturer of the material listed below that this product is to be withdrawn from the market and, therefore, it should be eliminated from the List of Certified Dental Materials.

CERTIFIED HYDROCOLLOIDAL IMPRESSION MATERIALS—AGAR TYPE
(A.D.A. SPECIFICATION NO. 11)

| *Material* | *Manufacturer or distributor* |
|---|---|
| Coe-Loid 66 | Coe Laboratories, Inc. |

BUREAU OF PUBLIC INFORMATION
COUNCIL ON DENTAL THERAPEUTICS
COUNCIL ON LEGISLATION

# American Dental Association statement on dentifrice advertising claims

Following is the third and final part of the testimony on advertising claims in dentifrice advertising presented by representatives of the American Dental Association on July 17, 1958, before the Subcommittee on Legal and Monetary Affairs of the U. S. House of Representatives.

The discussion of claims for Gardol was by Dr. Walter C. Hess, assistant dean and professor of biological chemistry, Georgetown University Schools of Medicine and Dentistry. The discussion of "bad breath" claims was presented on behalf of Dr. Donald A. Wallace, professor of applied materia medica and therapeutics, University of Illinois College of Dentistry, Chicago. The conclusions were presented by Ralph E. Creig of Cleveland, a member of the Association's Council on Legislation.

## DISCUSSION OF CLAIMS FOR "GARDOL" (DR. HESS)

My name is Walter C. Hess. I am assistant dean and professor of biological chemistry at Georgetown University Schools of Medicine and Dentistry. I received my bachelor of science degree (in chemistry) from the University of Pennsylvania in 1920, and also received a doctor of philosophy degree in biological chemistry in 1930. I have been in the field of biological chemistry for over 30 years and have written almost 200 papers describing research in which I have been engaged. My field of specialization is nutrition and protein chemistry and part of my research has been directed toward the biochemistry of tooth structure, particularly the protein components.

I have always been an experimental scientist and not a clinician. My approach to problems concerned with teeth and their composition has been that of a laboratory worker. I have tried to apply the standard technics of the protein chemist to obtain information concerning the structure of healthy and carious teeth. The clinicians, the dentists in our school clinics, tell me which teeth are healthy and which are carious, and I follow their guidance.

It would be worth while to have a laboratory test that could be used to tell the clinician when and if a person is going to develop dental caries. It would be equally desirable to have a laboratory test that could tell the clinician whether some substance that has been applied to a tooth is going to protect it against the future development of caries. One approach to these problems has been based upon the concept that caries results from the action of acid upon the tooth structure. The chemist can measure acid; he has very sensitive methods that can detect minute changes in acid concentration. These measurements can be done in saliva and they can even be done right on the surface of the tooth. We have instruments that can be applied to any part of the tooth in the mouth of the patient.

The usual source of the acid that is formed is the fermentation of sugar by microorganisms on the surface of the tooth. If one prepares a solution of sugar and simply holds some of it in the mouth for a minute and then spits it out, a film of the sugar solution is deposited on the teeth. If the degree of acidity of a tooth surface is measured before and after such a sugar rinse, the changes can be observed. In most individuals the sugar produces an increase in acid, an increase that persists for about ten minutes.

One logical approach to the problem of caries control would be to apply something to the surface of the teeth that would prevent the fermentation of the sugar. Such a substance could be incorporated into a tooth paste and simply brushing the teeth would confer immunity.

About five years ago an article appeared in the *Journal of Dental Research* describing a search for such a substance.[1] The test em-

ployed was the one I described; each substance was examined to determine whether it would prevent the fermentation of sugar. Several substances looked promising; one of these, sodium N-lauroyl sarcosinate, bearing the trade name of Gardol, was subjected to a series of tooth paste tests. These tests, according to Dr. Fosdick, the senior author of the article, indicated that Gardol prevented the formation of acid on the surface of the tooth.

Dr. B. K. Forscher and I repeated these experiments; we purchased Colgate's Gardol tooth paste in the open market, and used dental students as our subjects. We divided them into two groups; one group received the Gardol-containing tooth paste identified with only a distinguishing letter. The control group received a tooth paste containing no Gardol. The students were unaware of the nature of the tooth paste. The laboratory worker knew the students by name only, and had no knowledge whether the student was brushing with the Gardol-containing tooth paste or the control. The study was therefore a "double-blind" investigation, in which subjective influences were kept to the minimum. When the student came to the laboratory, the acidity of the surfaces of several teeth was measured; then he was given a fixed amount of sugar solution. After one minute the sugar solution was expectorated and acidity was measured. Two more measurements were made—at the end of five and ten minutes.

After the students had been brushing their teeth with the respective tooth pastes for several weeks and considerable data had been accumulated, the results were tabulated against the concealed information on the distribution of the two tooth pastes. No differences were found between the two groups of students; acid was formed in both cases. These results, in direct contradiction to those of Dr. Fosdick, were published in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION.[2]

Here, then, were two publications—one saying that Gardol prevents acid formation on the tooth surface, and the other saying it does not. What is needed in such a case is a third independent assay. Such was provided by Dr. Brudevold of Rochester,[3] and it in essence confirmed our finding. No rebuttal of these two "contra" papers has ever appeared. This has never had the slightest effect upon the Colgate advertising campaign. Gardol is still the magic shield that protects against the insidious onslaught of acid. Apparently, the advertisers ignore any scientific evidence which does not support or which challenges the thesis of their sales pitch.

The experiments I have been describing all are capable of being performed in any biochemical laboratory. Dr. Fosdick is not a dentist, and you would not expect him to furnish clinical evidence in support of Gardol. Yet in the journal *Science*, he offers clinical evidence purporting to show that the use of a tooth paste containing Gardol effectively prevents decay.[4] I am not a dentist either, but I am qualified to examine and evaluate clinical data. I have never examined the teeth of the test subjects, but Dr. Fosdick hasn't looked at them either. We are both just examining recorded figures.

In Dr. Fosdick's study, several groups of subjects were employed, living in different parts of the country. In the report these subgroups are designated as Gainesville, Miami, Meredith and Drake. They were examined by different examiners, and the health of their teeth was assayed; a numerical value can be obtained by counting the number of teeth that are decayed, missing, or filled. In this study the investigators recorded decayed, missing and filled tooth surfaces (DMF surfaces) and decayed or filled teeth (DF teeth) as units for measurement.

After the baseline examination, the several groups then used a Gardol tooth paste either once or twice a day, and control groups did the same thing with non-Gardol-containing tooth pastes. Dental examination one and two years later indicated new numerical DMF and DFT values of the dental health of the patient. A larger value at the later date means a deterioration of dental health during the period. All groups of the patients, whether they used Gardol or not, had larger numbers on the second examination. Evidently Gardol did not build an impenetrable shield against tooth decay.

The statistics showed that some reduction occurred in the appearance of new decay in the groups that used the Gardol tooth paste, as compared with the control groups. The net average increase in DF teeth over the two-year period for the Gardol groups is shown as 0.22 DFT units, or 22 new decayed or filled teeth per 100 patients. For the control groups the average increase was 0.47 DF teeth, or 47 new DF units per 100. But the variation in the

1. Fosdick, L. S., and others. New approach to the problem of dental caries control. J. D. Res. 32:486 Aug. 1953.

2. Forscher, B. K., and Hess, W. C. Validity of plaque pH measurements as a method of evaluating therapeutic agents. J.A.D.A. 48:134 Feb. 1954.

3. Brudevold, Finn; Little, Marguerite, and Rowley, Janet. A study of the acid-reducing effect of "anti-enzymes" in the mouth. J.A.D.A. 50:18 Jan. 1955.

4. Fosdick, L. S. Clinical experiment on the use of sodium N-lauroyl sarcosinate in the control of dental caries. Science 123:988 June 1, 1956.

amount of caries within the control groups and within the test groups was several times greater than this apparent change induced by Gardol.

For example, at the first examination the DFT values in the control groups (designated Group C-2-D in the report) varied from 16.0 in the Meredith subgroup to 19.7 in the Gainesville subgroup, a difference of 3.7 units or 370 DF teeth per 100. After two years the range was from 16.39 to 20.46, a difference of 4.07, or 407 DF teeth per hundred.

In the experimental groups (designated collectively as T-1-D), the initial DFT value ranged from 16.0 to 19.0, a difference of 3.0 DFT units; after two years the range was from 16.18 to 19.4, a variation of 3.22 DFT units.

The decay reduction claimed on the basis of the average figures of 0.47 DFT and 0.22 DFT is 53 per cent, based on the difference of 0.25 DFT units. But a claimed reduction of 0.25 units, if not absolutely meaningless, is certainly open to serious question in the face of internal variations of the order of 3.0 or more units within the groups themselves. The variation within the groups was as much as 12 times as great as the 0.25 unit difference that was claimed. Obviously there was something wrong with the methods employed for measurement of the effects.

By comparison, for the purpose of illustration, you might think of how accurately you could measure differences in the size of two pinheads if your ruler was a yardstick crudely marked off in eighths of an inch. Your baseline markings would be many times larger than the differences you were trying to measure, just as the baseline variations within these subgroups were many times larger than the difference in decay rates which these investigators were trying to measure.

These are some of the major inadequacies of the Gardol tooth paste investigation. They are more than sufficient to cast doubt on the significance claimed for the results. In situations like this, it is essential to have confirmatory evidence from independent studies. No confirmation or clarification of these clinical results appears in the literature.

It is interesting also to compare the results obtained in the subjects who brushed their teeth once a day with those who brushed twice a day. Previously Dr. Fosdick had reported that merely brushing the teeth twice a day, with an ordinary tooth paste, reduced the amount of caries.[5] In these Gardol studies, however, it made no difference whether the teeth were brushed once or twice a day; the same numerical values were obtained.

It is apparent that the advertising claims for protection against acid formation by Gardol are not supported by published data. In fact, the published data states just the contrary—two to one. The general public is in no position to distinguish between proven and unproven claims and needs some protection against claims that are demonstrably unfounded.

## DISCUSSION OF "BAD BREATH" CLAIMS (DR. WALLACE)

*Definition of Terms* • In advertising for certain dentifrices, references to "breath odor" and "mouth odor" appear (Fig. 10). "Breath odor" is a comprehensive term. It covers all the smells emanating from the linings of the mouth and the entire respiratory tract. "Mouth odor" includes only those odors arising from the oral surfaces. Needless to say, not all mouth odor or breath odor is objectionable.

It is necessary to distinguish carefully between breath odor and mouth odor. Conditions in the mouth account for only a fraction, perhaps 50 per cent, of the cases of malodorous breath. Less than this, perhaps 35 per cent of all the cases of malodorous breath can possibly be mitigated by the proper use of a dentifrice and toothbrush. This is because the sources of the breath odor lie in the respiratory tract in about half the instances, and, of the half that are in the mouth, about 30 per cent or so are caused by inaccessible filth or by diseases which cannot be controlled by oral hygiene.

Some cases of malodorous breath are attributable entirely to oral filth or to food debris. Since use of the brush, with or without a dentifrice, can help to clean oral surfaces, it is reasonable to suppose that oral hygiene would lower the intensity of mouth odor in some mouths. Unfortunately, many of us do not know when our breath is offensive. In many instances, even after we know we are offending, we cannot unearth the cause or get it remedied without professional help. It is not likely that any biologically sound method would deodorize the mouth completely.

*Measurement of Odor* • Odor is usually associated with animal or vegetable matter. It has two aspects which can be observed and recorded. It has quality; for example, onion-like, sweetish, rancid, yeasty, putrid, aromatic or fresh. It can also be described as pleasant or unpleasant. Regardless of its quality, odor can

5. Fosdick, L. S. The reduction of the incidence of dental caries. I. Immediate toothbrushing with a neutral dentifrice. J.A.D.A. 40:133 Feb. 1950.

Figure 10

vary in intensity. This is a quantitative aspect and can be measured. Adults have customarily been used as test subjects for such measurements. When odors which originate in adult mouths are strong, they are objectionable to most people. It is therefore defensible to select a certain level of adult mouth odor intensity as offensive. Such a policy narrows the applicability of the findings to adults, of course.

Odor intensity can be measured by sniffing or by forcefully introducing vapors from odoriferous material into the nose. It can also be estimated chemically, but chemical means are applicable only when the odoriferous substance can be isolated and is uniform in chemical nature. Mouth odor is caused by a variable mixture of substances, and it is therefore not susceptible to chemical measurement. The methods which have been generally adopted for measurement of mouth odor and breath odor depend upon sniffing.

Sniffing tests fall in two categories. In one kind, a measured volume of the vapor from the mouth is diluted with graded volumes of pure air until the technician who is sniffing can no longer detect any odor. The larger the volume of diluting air required, the higher the value assigned to the mouth odor. Depending upon the investigator and the instrument he uses for diluting the odorous vapors, the odor intensity numbers are designated as pO values, odor threshold numbers (OTN), and otherwise.

In the second type of sniffing test, a panel of trained technicians is offered samples of odorous mouth vapor to smell. These technicians assign a number to each sample, based upon its odor intensity.

All sniffing tests are subjective. All select some level of odor more or less arbitrarily as being objectionable and all produce results which have some significance. Our concern need not be with the somewhat unsatisfactory methods for measuring mouth odor, or with human error in carrying out the technical procedures, but with the interpretation of the values obtained.

Incidentally, devices used to dilute odorous vapors quantitatively are called osmoscopes or osmographs. There are several different varieties, not all of which are adequately described in the literature. Their relative merits are controversial, but it is not necessary to understand the details of their design or operation in order to evaluate odor claims made for dentifrices.

In support of its claims for Gleem tooth paste, Procter and Gamble submitted exhibits with a letter to the Subcommittee dated March 25, 1958. I would like to comment on the content of Exhibit 2.

The first paragraph of this exhibit will be passed over, because it does not deal with mouth odor.

Claims in controversy are stated in the exhibit as:

*Claim 2:* "To get . . . protection against mouth odor all day—always start the day with Gleem.

"Mouth odor stopped all day with *one* Gleem brushing. Scientific odor-measuring tests prove brushing with Gleem before breakfast gives most people *all-day* protection against mouth odor. . . ."

The exhibit continues:

"Clinical experience reported in the literature (Collective Review—FETOR EX ORE —M. Massler, D.D.S., M.S.: R. D. Emslie, B.D.S., M.S.: T. E. Bolden, A.B., D.D.S.; *Oral Surgery, Oral Medicine* and *Oral Pathology,* January, 1951) points out that odors originating in the mouth are probably caused by the bacterial putrefaction of food debris and saliva."

The article cited is a competently written review of the literature on breath and mouth odor supplemented by observations made by the authors, who are dentists. It deals with the historical aspects, measurements of mouth and lung odors, the odor of normal breath at various ages and in various species of animals, and the origin of breath odors. Treatment is also discussed.

Under "Origin of Local Fetor ex Ore," retention of food around the teeth, putrefaction of saliva and the presence of oral disease were given about equal emphasis. In its statement, already quoted, the firm overlooks the stress which the article places on factors which its dentifrice could not be expected to control, such as oral disease.

The exhibit continues:

"Gleem's mouth odor claims are based on tests carried out by *Procter & Gamble* and by *Evans Research and Development Corporation*, 250 East 43rd Street, New York, New York. Our own work on mouth odor had shown that brushing with Gleem had an effect much greater than could be accounted for by any short-lived masking effect of the flavor ingredients. As a result, we asked Evans, an independent research laboratory with considerable experience in odor evaluation, to do further work. A trained sensory panel in the Evans organization made 2,425 observations of mouth odor levels. The study was done in three series of evaluations as follows:

"1. *Pilot Study to Test Procedure*. This study was run for five consecutive days during which period the subjects had breakfast as usual but did not brush their teeth with Gleem until after the first, or control, observation for mouth odor was made at 9:30 each morning. As indicated on the graph attached to the exhibit, mouth odor level showed a two point drop after brushing with Gleem and remained at a significantly lower level through the day. Thus, mouth odor level went down and stayed down.

"2. *Study to Measure the Effect of No Brushing on Mouth Odor Level*. The second series of evaluations were conducted for four consecutive days during which period the subjects did not brush their teeth at all. Observations were made throughout the day to check the level of mouth odor. As indicated on the attached graph, mouth odor level remained high and never went down to the lower level achieved by those subects who did brush their teeth.

"3. *Same Study as Pilot Study, Expanded to Confirm Results*. The final evaluation with a larger group of subjects ran for two consecutive days. The subjects had breakfast at home but did not brush their teeth with Gleem until after the first, or control, observation for mouth odor was made at 9:30 each morning. Additional checks were made throughout the day. As indicated on the attached graph, the mouth odor level showed a drop of almost three points after brushing with Gleem and remained at a significantly lower level throughout the day. As in the Pilot Study, mouth odor level went down and stayed down."

Only averages are given on the graph referred to in the quotation. The average mouth odor level in the absence of brushing (item 2) was 6 units at 9:30 and averaged about 5.5 for the period to 4 o'clock. The group reported under item one averaged about 4.4 before brushing, dropped to about 2.3 after brushing and rose to about 3.3 during the rest of the test period. The group referred to in item 3 averaged 6.2 before brushing, 3.4 immediately after brushing and 4.3 during the rest of the test period.

While it is stated that 2,425 "observations" were made, it is not possible to tell how many subjects (individuals who were subjected to test) were used. The exhibit does not say that the mouth odor of any of the subjects was objectionable at any time. In fact, the population tested is not described. The baseline measurement of odor intensity was made at 9:30 in the morning, after breakfast. It is generally known that mouth odor usually falls and levels off shortly after breakfast. It is not surprising, therefore, that brushing with Gleem made little difference in mouth odor intensity under the stated conditions. Observations were taken until 4 P. M., only 6½ hours after brushing. This can hardly be considered "all-day" or "through the day."

All the data in this section of the exhibit were obtained by a panel method. The meaning of the values and the details of the observations are not given. It is therefore not possible to evaluate many aspects of the tests.

In the remainder of the exhibit, an experiment conducted by employees of the firm is described. Six women and ten men gave samples of "mouth odor" as soon as possible after arising and without having eaten, smoked, brushed their teeth, or taken water. Teeth were brushed immediately thereafter with Gleem, the subjects ate breakfast, and gave another set of mouth odor samples. Additional odor samples were collected just before lunch, immediately after lunch, and about three hours after lunch.

The exhibit concludes:

"Of the sixteen people on the panel, only five provided any samples having a score of 8 (offensive) or more at any time on the same day after having brushed their teeth once (before breakfast) with Gleem. In this study then, there were eleven out of sixteen (7 out of 10) people who after brushing before breakfast with Gleem, did not have an offensive mouth odor during the day."

The numerical values given in the quotation were obtained by a different method than those reported by the Evans panel, and the

Evans numbers presumably cannot be compared directly with them.

The nature of the population is defined very sketchily, only the number of each sex and the fact that they were adults being mentioned. It is not stated whether the odors from the mouths of the 16 subjects were offensive at the beginning of the test.

A basic weakness in the test is the fact that breakfast and brushing took place between the collection of the first and second samples. Thus it was impossible to tell which factor, breakfast or brushing, influenced the odor intensity values obtained after brushing.

One might infer from the information in the exhibit that brushing and breakfast took place between eight and nine o'clock in the morning and that the after-brushing values were obtained over a period of about six or seven hours. It is obvious that 30 per cent of the 16 subjects exhibited offensive breath, by the firm's criteria, by four o'clock or so.

Moreover, in none of the studies was a control test made in which the subjects used only a toothbrush, without Gleem tooth paste. The mechanical removal of residues by the brush itself may be expected to give improved odor ratings. The essentiality of Gleem in producing the results observed after brushing was not tested at all.

In summary, the exhibit does not justify the claims "protection against mouth odor all day. . . ." and "Mouth odor stopped all day with one Gleem brushing." There is nothing in it to suggest that mouth odors were "stopped" in any of the subjects for any period of time.

In connection with the bad breath prevention claims for Ipana tooth paste, the Bristol-Myers Company submitted a report by its consultant, Dr. Louis C. Barail, dated April 5, 1957. The following are pertinent excerpts:

"The purpose of this study was to establish the efficiency of Ipana Toothpaste in removing mouth odors of local origin after various periods of time.

*"Selection of Subjects* • Fifty subjects of both sexes participated in this investigation. Twenty-six males and twenty-four females were selected from a greater number of individuals in order to meet the following requirements:

1. The original Odor Threshold Numbers (OTNs) of the mouth odor before brushing the teeth should be above 8.6, therefore above average.
2. The odor should be due to local causes only.

In order that the odor to be measured could not be attributed to any extraneous causes, the 50 subjects were instructed not to eat spicy foods or condiments during the day preceding the tests. They were not allowed to brush their teeth before the first OTN determination.

*"Brushing and Rinsing Procedure* • Each subject was given a Tek medium toothbrush and a tube of Ipana. Approximately one gram of dentifrice was evenly applied on each brush. He then brushed his teeth in his usual manner for 45 seconds, rinsed his mouth three times with approximately 1½ ounces of water each time, and rinsed his toothbrush in running water. He brushed his teeth again for 30 seconds, rinsed his mouth thrice as before and was dismissed until the next OTN determination. Brushing and rinsing were timed by means of a stop watch."

"Odor threshold numbers (OTN values) were determined before brushing and four and nine hours after brushing. Odor was detected in 28 of the four-hour samples and in 37 of the nine-hour samples. All OTN's were below 8.6 (the value chosen as objectionable) at four hours. After nine hours, all OTN values were lower than the original ones, but seven were 8.6 or above."

The following important information is not given in the report:

1. Ages of test subjects.
2. Conditions under which "original" OTN's were measured.
3. Time of day brushing was done.
4. OTN values obtained over a similar period without brushing the teeth.

The data cover a period of only nine hours. They indicate that approximately 14 per cent of the subjects developed objectionable mouth odors between four and nine hours after thorough brushing with Ipana. It is not possible to tell from this report how many would have developed objectionable mouth odors if they had not brushed with Ipana.

The data certainly do not justify claims such as "Not a whisper of bad breath" and ". . . prevents bad breath." Note that the firm says "breath" and not "mouth odor." The claims would be misleading even if they were limited to mouth odor, since people often cannot tell where odors originate. Use of the term "bad breath" is more misleading.

## CONCLUSIONS (DR. CREIG)

It seems obvious that only the federal government has the resources effectively to control misleading and deceptive claims for nationally advertised products. It seems equally obvious that with respect to therapeutic claims for dentifrices, and, it might be observed, for a variety of proprietary nostrums, such control is either woefully inadequate or nonexistent.

One has only to glance at the commercials on television or in the pages of any newspaper or magazine to find the pitchmen touting their wares—from tooth paste to headache pills—in such glowing terms that if only half of what they say is true, we all can go through life serenely, healthfully, without discomfort of any kind, simply by purchasing a tube of tooth paste, a package of pills and a bottle of tonic. This propaganda, reeking with high-sounding but meaningless scientific terms and formulae, carefully hedged to skirt the law, and designed to entrap the hopeful but unwary consumer, floods the airwaves and gluts the printed page. It is distinguishable from the harangue of the old-time medicine show only in that the approach is more subtle and the audience more vast.

It is regrettable but understandable that advertising of this type is successful. It is successful because it preys upon the age-old desire of human beings to find the permanent panacea for pain and disease. And, it is successful to the tune of millions upon millions of dollars a year.

Something should be done about these abuses. The public is not well enough informed to protect itself. This is pathetically apparent in the case of some advertisements directed toward children. The disparity of knowledge between the manufacturer and the consumer is too great.

When an individual is told that the maker of a dentifrice has had hundreds of scientists working and has spent millions of dollars to develop a miracle ingredient that will prevent tooth decay if dabbed on the toothbrush once a day, he believes it. He believes further that the government doesn't allow advertisers to make claims that are false or half true.

He doesn't know that only a few individuals developed the "miracle ingredient"; that often its germ-killing qualities have never been tested in the mouth and that even on the laboratory plate, the "magic" drug killed only some of the bacteria. He doesn't realize that the "dentist" or the "hygienist" pictured in the ads is merely an actor or actress in a white coat. He misses the asterisk and the fine print which qualifies the broad claims made in the bold print.

In short, the consumer is completely "taken in." The unscrupulous among the advertisers know how to take him in and they exploit him mercilessly and endlessly.

If this exploitation resulted only in economic loss to the consumer, perhaps it could be excused. But, as has been demonstrated, it does not stop there. The purchaser of the product is lulled by the advertising into a false sense of security concerning his physical well-being; he is encouraged to neglect his health.

The American Dental Association has done as much as it is possible to do to counteract the effects of misleading dentifrice advertising. The Association has distributed hundreds of thousands of copies of this leaflet *Don't be misled*—, which I should like to submit for the record. We have developed and disseminated sound information such as that contained in the leaflet entitled *Toothbrushing* and in the brochure, *Diet and Dental Health*, both of which I submit for the record.

In addition, the Association, recognizing the need for sound and uniform scientific methods to replace the many and varied technics employed in studying the possible therapeutic effects of dentifrices, sponsored in 1953 a Conference to Develop Uniform Standards and Procedures in Clinical Studies of Dental Caries. This Conference, which was attended by 50 of the foremoit authorities in the field, resulted in the publication of the report *Clinical Testing of Dental Caries Preventives* which is offered for the record. This report is available to all who contemplate clinical studies of the effectiveness of dentifrices in controlling decay and it was our hope that the sound principles set forth in its pages would be followed in testing new products.

Since its inception nearly 30 years ago, the Council on Dental Therapeutics, an agency of the Association, has evaluated dentifrice advertising claims and has issued reports periodically for the information of members of the profession.

It is evident, however, that all the efforts of the Association hitherto have failed to prevent or neutralize the effects of the misleading advertising claims which the dentifrice manufacturers continue to issue. The problem of combatting a multimillion dollar sales campaign is one which the limited facilities of the Association cannot solve.

We, therefore, have turned on several occasions to seek the assistance and intervention of the government agency charged with the responsibility of controlling false and misleading advertising. In January 1956, the Federal Trade Commission was requested to take action regarding claims then appearing in dentifrice advertising. It was suggested that the FTC give consideration to calling a trade conference of dentifrice advertisers with a view to adopting an appropriate advertising code for the dentifrice industry. In reply, the Commission indicated, in effect, that it was powerless to act. It was pointed out that "in Commission proceedings the burden of establishing the falsity of claims is upon the Commission. The mere fact that advertisers have not adequately established that the claims made for

their products are true does not provide sufficient basis for the Commission to sustain action under its procedure to require their discontinuance." The Commission stated further that an advertising code to be effective must be "capable of enforcement by mandatory means."

A similar response was received by the California State Dental Association, the FTC stating that ". . . the Commission bears the burden of proving that challenged representations are in fact false and misleading. It is not sufficient to establish that the advertiser does not possess sufficient evidence to clearly support the validity of his claims."

Copies of the afore-mentioned correspondence are offered for inclusion in the record.

The Association believes that the advertising claims which have been presented here today are "misleading" within the meaning of Section 15 of the Federal Trade Commission Act which provides:

"(a) (1) The term 'false advertisement' means an advertisement, other than labeling, which is misleading in a material respect; and in determining whether any advertisement is misleading, there shall be taken into account, among other things, not only representations made or suggested by statement, word, design, device, sound, or any combination thereof, but also the extent to which the advertisement fails to reveal facts material in the light of such representations or material with respect to consequences which may result from the use of the commodity to which the advertisement relates under the conditions prescribed in said advertisement, or under such conditions as are customary or usual."

The Association believes that, by allowing the dentifrice advertisers to continue to make misleading claims without taking appropriate enforcement action, the Federal Trade Commission is failing to discharge its statutory responsibilities.

Where the health of the public is involved, as it is here, the government is completely justified in requiring a high standard of responsibility from industry. At the present time that standard is lacking. Dentifrice manufacturers have been and are selling health promises to the American public with no apparent concern as to whether such promises can be fulfilled; history demonstrates that in the vast majority of cases they have not approached fulfillment. A long list of successive advertising themes have been pushed strenuously and then abandoned when their selling power disappeared.

The burden of demonstrating the validity of therapeutic claims in advertising belongs morally, ethically and logically with the party asserting them. The current concept that such claims must be considered to be true and unchallengeable until disproved by the public is fallacious and demonstrably ineffective.

Based on the 30 years of experience which the Association's Council on Dental Therapeutics has had, it is our opinion that the FTC does not have the facilities to evaluate the claims for dentifrices, let alone the claims for the thousands of proprietary drugs which are being marketed today. It is hopeless and naive to expect the small scientific staff of the FTC to establish the truth or falsity of every claim which the advertisers, by whim or otherwise, feel like making. (This is not to say that something could not be done about the blatant and obviously misleading claims that frequently appear.)

Parenthetically, it might be observed that perhaps the Food and Drug Administration is more adequately staffed and equipped than the Federal Trade Commission and thus may be better able to control dentifrice and drug advertising. It would seem, moreover, that this function would dovetail efficiently with the Food and Drug Administration's existing jurisdiction over new drugs and labeling.

In the final analysis, however, it appears that the answer to the problem lies in the adoption of legal remedies and procedures which would shift the major burden of proof from the government to the advertiser. There would appear to be no sound reason why advertisers who choose to make representations as to the efficacy of their products in preventing or curing disease should not, upon reasonable cause shown, be called upon to substantiate such representations with scientifically acceptable evidence. This might be accomplished by establishing requirements similar to those now applied by the Food and Drug Administration in determining the safety of drugs before new drug applications may become effective.

There are, of course, other remedies that might be applied effectively to control the careless and reckless use of therapeutic claims in advertising. This, however, is a proper function for legal and legislative experts rather than for health scientists.

We are here today only to point out that some regulatory mechanism is sorely needed. The existing system is not controlling abuses in dentifrice advertising. The American Dental Association and the Academy of Periodontology and health organizations throughout the country agree that something more needs to be done.

The Association, therefore, welcomes this opportunity to lay these facts before this Committee. It is requested that your attention be given to the solution of the problem.

COUNCIL ON DENTAL HEALTH

# Dental care and some "outside" shaping forces

Among representatives of the dental profession in attendance at the 8th Annual Group Health Institute of the Group Health Federation of America in Vancouver, B. C., July 22-25, was G. T. Chuljian of Port Townsend, Wash., president of the Washington State Dental Service Corporation. His report to the W.S.D.S.C. board of trustees and the executive committee of the Washington State Dental Association of his observations during the meeting holds such significance for the dental profession in other states that the Council arranged to have it published in the Council section of THE JOURNAL. Dr. Chuljian's report follows:

The Group Health Federation of America is an organization made up of cooperative health prepayment type of plans. Its member units are spread all over the United States and Canada and, through associate memberships, include many labor union groups. About one and one-half million people are covered by their operations. It is interesting to note that many of the Canadian groups obtain care for their subscribers from open panels of practitioners, thus allowing free choice of doctor, whereas apparently the chief method of obtaining care by the United States units is through closed panels of doctors in group type practice although some plans are of the insurance type.

These closed-panel type organizations, which compete with and in effect oppose traditional free-choice-of-doctor methods of practice, are strongly controlled by laymen. The doctor is the employee and unquestionably under lay control in many ways. Speakers at the meeting claimed this arrangement was necessary to assure subscribers of quality control in obtaining needed health care. Needless to say, such a statement would have been challenged anywhere else but at this meeting.

The Federation seems to contain many groups whose views probably vary widely on different matters. One lay speaker representing an eastern labor group stated that the final goal would be reached only when the government could be induced to assume the responsibility of giving adequate health care to all. I doubt this statement would represent the philosophy of all of the other groups present at the meeting. I had the feeling that some elements present would not or could not face the possibility that the common goal of better health care for all had to be reached within the limits of this country's available resources. They, in effect, suggested that since no other way could be seen presently of achieving this ultimate goal, the government was the only hope of reaching it.

A most interesting talk was given the last day by the Minister of Health and Welfare of British Columbia who explained and gave the history of its free-to-all hospitalization plan. The plan has experienced large deficits in its operation, but it was apparent that this official, upon his election, had attempted to solve the problem only by trying to find a more popular way of paying for it. The answer in this case was to increase the sales tax and the subsidies. Apparently no thought was given to curbing possible over-utilization of the plan or attempting to limit it in any way to those in need of such free care.

The session titled "Quality and Cost Control in Prepaid Dental Plans" was of the greatest interest to me. Most of the speakers represented closed-panel type

practices. I was not greatly convinced by many speakers' claims that by employing a closed panel they greatly increased efficiency, assured better quality dentistry and greatly reduced costs. Some of the claims made seemed to be more on the order of opinions than facts, and no actual statistics were furnished to prove any points. On occasion some of the panelists contradicted each other. Although a speaker from a local dental firm asserted there were great savings to patients from group plans, another from Washington, D. C., stated there could be little savings in dollars. This physician-speaker, who was the director of the latter plan, made the surprising statement that very few dentists after graduation were qualified to treat patients properly. He did not say how he was able to make such a determination. The W.S.D.S.C. was the recipient of praise for its first program when the International Longshoremen's & Warehousemen's Union Pacific Maritime Association welfare director spoke on the workings of the plan. She left no doubt that the organization she represented was pleased with the free-choice type of dental plan it had selected.

Although nearly all those at the meeting opposed dentistry's traditional concept of professional practice and although they represented powerful groups, many of laymen, I came away from the meeting optimistic in the feeling that dentistry in our state has taken several large steps forward in meeting its obligations to the public it serves.

I feel certain that we can successfully meet the challenges that may lie ahead and that we can give the most effective dental care to all through the free-choice methods of private practice. The W.S.-D.S.C. can continue to be a most useful tool in meeting the increasing demands or needs for prepayment type of plans while preserving the traditional patient-dentist relationship.

I sincerely wish that more of our officers could have attended the meeting, for I am sure they, too, would have found it to be most informative, as I did—and, perhaps, made more aware of some of the "outside" shaping forces that affect our profession.

I could not close without paying high praise to our British Columbia hosts who truly showered us with hospitality. No effort was spared to make ours a most enjoyable and profitable visit.

BUREAU OF ECONOMIC RESEARCH AND STATISTICS

# The ILWU-PMA dental program: first year statistics. IV. The nine dental plans

The nine separate plans into which the program was divided differed considerably in amount of dental service provided per patient. This variation was a function of the following variables and possibly others: (1) type and administration of plan, particularly the distinction between service and insured plans; (2) age-sex-race of patients; (3) geographic differences in incidence of dental disease and (4) geographic differences in dental practice. As shown in Chapter III, length of time since last visit to a dentist, a variable which itself is partially a function of age-sex-race and incidence of

The first three articles in this series appeared in The Journal in August, September and October 1958.

**Table 16 • Distribution of patients receiving initial care in each plan, by age and sex**

| Age | San Francisco Service | | | San Francisco Insured | | | Wilmington Service | | | Wilmington Insured | | | Oregon Service | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both |
| 1 | 4 | 2 | 6 | 0 | 0 | 0 | 33 | 20 | 53 | 2 | 0 | 2 | 1 | 1 | 2 |
| 2 | 22 | 20 | 42 | 9 | 2 | 11 | 42 | 45 | 87 | 5 | 3 | 8 | 13 | 11 | 24 |
| 3 | 39 | 31 | 70 | 9 | 16 | 25 | 61 | 57 | 118 | 13 | 21 | 34 | 30 | 27 | 57 |
| 4 | 52 | 41 | 93 | 20 | 21 | 41 | 66 | 56 | 122 | 24 | 20 | 44 | 27 | 45 | 72 |
| 5 | 53 | 51 | 104 | 27 | 29 | 56 | 73 | 60 | 133 | 22 | 27 | 49 | 43 | 57 | 100 |
| 6 | 65 | 51 | 116 | 31 | 39 | 70 | 45 | 64 | 109 | 30 | 28 | 58 | 52 | 63 | 115 |
| 7 | 65 | 64 | 129 | 40 | 38 | 78 | 59 | 62 | 121 | 35 | 42 | 77 | 55 | 56 | 111 |
| 8 | 66 | 58 | 124 | 52 | 46 | 98 | 70 | 50 | 120 | 25 | 31 | 56 | 50 | 55 | 105 |
| 9 | 54 | 55 | 109 | 42 | 41 | 83 | 69 | 48 | 117 | 21 | 33 | 54 | 54 | 41 | 95 |
| 10 | 58 | 67 | 125 | 48 | 49 | 97 | 51 | 63 | 114 | 33 | 32 | 65 | 49 | 53 | 102 |
| 11 | 64 | 56 | 120 | 46 | 55 | 101 | 68 | 52 | 120 | 31 | 40 | 71 | 54 | 54 | 108 |
| 12 | 54 | 59 | 113 | 46 | 57 | 103 | 76 | 59 | 135 | 31 | 28 | 59 | 49 | 64 | 113 |
| 13 | 49 | 49 | 98 | 48 | 46 | 94 | 68 | 51 | 119 | 30 | 26 | 56 | 58 | 36 | 94 |
| 14 | 57 | 46 | 103 | 46 | 45 | 91 | 71 | 47 | 118 | 26 | 29 | 55 | 50 | 44 | 94 |
| All ages | 702 | 650 | 1,352 | 464 | 484 | 948 | 852 | 734 | 1,586 | 328 | 360 | 688 | 585 | 607 | 1,192 |

| Age | Oregon Insured | | | Washington Service | | | Washington Insured | | | California Small Ports Insured | | | All plans | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both |
| 1 | 0 | 0 | 0 | 6 | 9 | 15 | 2 | 1 | 3 | 1 | 1 | 2 | 49 | 34 | 83 |
| 2 | 0 | 0 | 0 | 36 | 22 | 58 | 0 | 1 | 1 | 6 | 2 | 8 | 133 | 106 | 239 |
| 3 | 0 | 0 | 0 | 40 | 45 | 85 | 2 | 4 | 6 | 6 | 6 | 12 | 200 | 207 | 407 |
| 4 | 0 | 0 | 0 | 61 | 47 | 108 | 2 | 2 | 4 | 12 | 11 | 23 | 264 | 243 | 507 |
| 5 | 0 | 1 | 1 | 49 | 46 | 95 | 2 | 4 | 6 | 16 | 18 | 34 | 285 | 293 | 578 |
| 6 | 0 | 2 | 2 | 76 | 57 | 133 | 2 | 2 | 4 | 24 | 22 | 46 | 325 | 328 | 653 |
| 7 | 0 | 0 | 0 | 55 | 65 | 120 | 4 | 4 | 8 | 15 | 22 | 37 | 328 | 353 | 681 |
| 8 | 2 | 0 | 2 | 74 | 63 | 137 | 3 | 2 | 5 | 23 | 16 | 39 | 365 | 321 | 686 |
| 9 | 0 | 1 | 1 | 58 | 53 | 111 | 3 | 4 | 7 | 23 | 23 | 46 | 324 | 299 | 623 |
| 10 | 0 | 0 | 0 | 69 | 55 | 124 | 1 | 5 | 6 | 18 | 15 | 33 | 327 | 339 | 666 |
| 11 | 0 | 0 | 0 | 53 | 62 | 115 | 6 | 8 | 14 | 23 | 18 | 41 | 345 | 345 | 690 |
| 12 | 1 | 4 | 5 | 67 | 73 | 140 | 3 | 5 | 8 | 27 | 20 | 47 | 354 | 369 | 723 |
| 13 | 0 | 0 | 0 | 52 | 59 | 111 | 4 | 2 | 6 | 22 | 20 | 42 | 331 | 289 | 620 |
| 14 | 0 | 0 | 0 | 58 | 70 | 128 | 2 | 0 | 2 | 16 | 24 | 40 | 326 | 305 | 631 |
| All ages | 3 | 8 | 11 | 754 | 726 | 1,480 | 36 | 44 | 80 | 232 | 218 | 450 | 3,956 | 3,831 | 7,787 |

dental disease, varied somewhat among the nine plans.

As explained in Chapter I, there was a monetary limit on the amount of care an individual child could receive under the insured plans. This limit was $75 in California and $95 in Oregon and Washington. There was no dollar limit for the individual patient under the service plans. When the patient in an insured plan received care beyond the stipulated monetary limit, such care is included in the statistics on dental services received.

It seems reasonable to assume that complete care was received by a smaller proportion of patients in the insured plans than in the service plans, because of the monetary limit. It seems likely, also, that children with a large amount of accumulated dental need tended to choose service plans rather than insured plans, as noted in Chapter III. Both of these factors would tend to lower the average amount of service received per child in the insured as compared to the service plans.

**Table 17** • Distribution of patients receiving recall care in each plan, by age and sex

| Age | San Francisco Service | | | San Francisco Insured | | | Wilmington Service | | | Wilmington Insured | | | Oregon Service | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 1 | 2 | 2 | 0 | 2 | 30 | 33 | 63 | 1 | 1 | 2 | 3 | 3 | 6 |
| 3 | 6 | 4 | 10 | 1 | 5 | 6 | 33 | 32 | 65 | 6 | 8 | 14 | 11 | 16 | 27 |
| 4 | 10 | 6 | 16 | 6 | 3 | 9 | 27 | 31 | 58 | 8 | 5 | 13 | 8 | 21 | 29 |
| 5 | 13 | 15 | 28 | 6 | 7 | 13 | 27 | 27 | 54 | 5 | 9 | 14 | 23 | 24 | 47 |
| 6 | 15 | 11 | 26 | 6 | 9 | 15 | 21 | 26 | 47 | 5 | 9 | 14 | 23 | 26 | 49 |
| 7 | 10 | 15 | 25 | 2 | 8 | 10 | 16 | 22 | 38 | 7 | 16 | 23 | 27 | 25 | 52 |
| 8 | 11 | 16 | 27 | 9 | 7 | 16 | 23 | 15 | 38 | 3 | 8 | 11 | 27 | 27 | 54 |
| 9 | 13 | 9 | 22 | 6 | 10 | 16 | 24 | 17 | 41 | 4 | 7 | 11 | 21 | 20 | 41 |
| 10 | 17 | 19 | 36 | 5 | 8 | 13 | 15 | 24 | 39 | 12 | 9 | 21 | 25 | 28 | 53 |
| 11 | 19 | 14 | 33 | 6 | 9 | 15 | 24 | 18 | 42 | 8 | 18 | 26 | 23 | 20 | 43 |
| 12 | 14 | 17 | 31 | 8 | 8 | 16 | 31 | 24 | 55 | 8 | 8 | 16 | 25 | 29 | 54 |
| 13 | 15 | 14 | 29 | 10 | 8 | 18 | 16 | 19 | 35 | 8 | 4 | 12 | 29 | 15 | 44 |
| 14 | 11 | 5 | 16 | 6 | 2 | 8 | 11 | 6 | 17 | 4 | 4 | 8 | 13 | 14 | 27 |
| All ages | 155 | 146 | 301 | 73 | 84 | 157 | 304 | 296 | 600 | 79 | 106 | 185 | 258 | 268 | 526 |

| Age | Oregon Insured | | | Washington Service | | | Washington Insured | | | California Small Ports Insured | | | All plans | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both | Boys | Girls | Both |
| 1 | 0 | 0 | 0 | 2 | 7 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 9 | 17 |
| 2 | 0 | 0 | 0 | 12 | 7 | 19 | 0 | 1 | 1 | 1 | 1 | 2 | 50 | 46 | 96 |
| 3 | 0 | 0 | 0 | 13 | 16 | 29 | 0 | 0 | 0 | 1 | 2 | 3 | 71 | 84 | 155 |
| 4 | 0 | 0 | 0 | 23 | 24 | 47 | 0 | 1 | 1 | 2 | 2 | 4 | 84 | 92 | 176 |
| 5 | 0 | 1 | 1 | 23 | 23 | 46 | 0 | 1 | 1 | 1 | 1 | 2 | 98 | 108 | 206 |
| 6 | 0 | 1 | 1 | 39 | 21 | 60 | 1 | 1 | 2 | 1 | 4 | 5 | 110 | 108 | 218 |
| 7 | 0 | 0 | 0 | 25 | 37 | 62 | 0 | 0 | 0 | 2 | 4 | 6 | 90 | 128 | 218 |
| 8 | 1 | 0 | 1 | 45 | 29 | 74 | 0 | 1 | 1 | 3 | 2 | 5 | 122 | 104 | 226 |
| 9 | 0 | 0 | 0 | 26 | 22 | 48 | 1 | 1 | 2 | 1 | 5 | 6 | 95 | 91 | 186 |
| 10 | 0 | 0 | 0 | 36 | 27 | 63 | 1 | 2 | 3 | 3 | 1 | 4 | 114 | 117 | 231 |
| 11 | 0 | 0 | 0 | 27 | 38 | 65 | 1 | 0 | 1 | 3 | 2 | 5 | 111 | 121 | 232 |
| 12 | 0 | 2 | 2 | 27 | 34 | 61 | 3 | 0 | 3 | 4 | 2 | 6 | 118 | 124 | 242 |
| 13 | 0 | 0 | 0 | 23 | 23 | 46 | 0 | 0 | 0 | 4 | 4 | 8 | 108 | 87 | 195 |
| 14 | 0 | 0 | 0 | 9 | 11 | 20 | 0 | 0 | 0 | 2 | 3 | 5 | 56 | 45 | 101 |
| All ages | 1 | 4 | 5 | 330 | 319 | 649 | 7 | 8 | 15 | 28 | 33 | 61 | 1,235 | 1,264 | 2,499 |

The age distribution of boys and girls receiving initial and recall care in each plan is shown in Tables 16 and 17. The percentage of patients returning for recall treatment was higher for service plans than for corresponding insured plans, except in Oregon where only 11 children received care under the insured plan. For the four service plans combined, 37.0 per cent of the patients returned for recall care, compared to only 19.4 per cent for the insured plans.

The percentage age distribution of patients receiving initial care is shown in Table 18. (Statistics on the Oregon insured plan are omitted from Table 18 and other tables because of the extremely low number of cases. Totals, however, include the Oregon insured plan.) For most plans the age distribution was similar, with a mean of about 8.5 years. Patients were older than average, however, in the San Francisco insured plan (mean age 9.3) and the California small

**Table 18** • Percentage distribution by age of patients receiving initial care in eight of the nine plans

| Age | San Francisco Service | San Francisco Insured | Wilmington Service | Wilmington Insured | Oregon Service | Washington Service | Washington Insured | California Small Ports Insured | All plans |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .4 | .0 | 3.3 | .3 | .2 | 1.0 | 3.8 | .4 | 1.1 |
| 2 | 3.1 | 1.1 | 5.5 | 1.2 | 2.0 | 3.9 | 1.2 | 1.8 | 3.1 |
| 3 | 5.2 | 2.6 | 7.4 | 4.9 | 4.8 | 5.7 | 7.5 | 2.7 | 5.2 |
| 4 | 6.9 | 4.3 | 7.7 | 6.4 | 6.0 | 7.3 | 5.0 | 5.1 | 6.5 |
| 5 | 7.7 | 5.9 | 8.4 | 7.1 | 8.4 | 6.4 | 7.5 | 7.6 | 7.4 |
| 6 | 8.6 | 7.4 | 6.9 | 8.4 | 9.6 | 9.0 | 5.0 | 10.2 | 8.4 |
| 7 | 9.5 | 8.2 | 7.6 | 11.2 | 9.3 | 8.1 | 10.0 | 8.2 | 8.7 |
| 8 | 9.2 | 10.4 | 7.6 | 8.2 | 8.8 | 9.3 | 6.2 | 8.7 | 8.8 |
| 9 | 8.1 | 8.8 | 7.4 | 7.8 | 8.0 | 7.5 | 8.8 | 10.2 | 8.0 |
| 10 | 9.2 | 10.2 | 7.2 | 9.5 | 8.6 | 8.4 | 7.5 | 7.3 | 8.6 |
| 11 | 8.9 | 10.7 | 7.6 | 10.3 | 9.0 | 7.8 | 17.5 | 9.1 | 8.8 |
| 12 | 8.4 | 10.9 | 8.5 | 8.6 | 9.5 | 9.5 | 10.0 | 10.5 | 9.3 |
| 13 | 7.2 | 9.9 | 7.5 | 8.1 | 7.9 | 7.5 | 7.5 | 9.3 | 8.0 |
| 14 | 7.6 | 9.6 | 7.4 | 8.0 | 7.9 | 8.6 | 2.5 | 8.9 | 8.1 |
| All ages | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Mean age | 8.4 | 9.3 | 7.9 | 8.7 | 8.6 | 8.4 | 8.4 | 9.0 | 8.5 |

ports insured plan (mean age 9.0), and younger than average in the Wilmington service plan (mean age 7.9).

In most of the plans, no information was recorded on the race of the patient. In the Wilmington service plan, 90 per cent of the patients were white and 10 per cent nonwhite. It is known that a very large proportion of the patients in the San Francisco service plan were Negroes. There were no Negro patients in the Oregon plans.

The variation in number of services received per child in the various plans is large, particularly for certain services (Tables 19 and 20). The percentage of patients receiving prophylaxes in initial episodes, for example, varied from 86.2 per cent in the San Francisco service plan to 27.6 per cent in the Washington service plan. In Oregon and Washington bitewing roentgenograms were used much more frequently than full-mouth roentgenograms; this was not true in California except in the small ports insured plan.

The number of fillings received per patient was higher for each service plan than for the corresponding insured plan in the initial series. The number of fillings received per patient in the Wilmington service plan was lower than in any other service plan; also, the Wilmington insured plan recorded a lower number of fillings than any other insured plan. Wilmington also had the lowest average number of extractions in the initial episodes.

In the recall series, Wilmington continued to have the lowest number of fillings per patient for both service and insured plans, suggesting a relatively low rate of dental decay. The two San Francisco plans ranked second in this respect. The number of fillings required in the recall episodes was higher than the program average in Oregon and Washington, and, somewhat surprisingly, in the California small ports.

Sodium fluoride treatments were provided in the initial episode to between 16 per cent and 19 per cent of patients in the Washington and Oregon plans, compared to only 2.4 per cent in the San Francisco service plan. In the recall episodes, the Wilmington service plan provided sodium fluoride treatments to 73.8 per cent of the 600 patients, almost

**Table 19** • Dental services received in initial episodes, for eight of the nine plans

| Service | San Francisco Service | | San Francisco Insured | | Wilmington Service | | Wilmington Insured | | Oregon Service | | Washington Service | | Washington Insured | | California Small Ports Insured | | All plans | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. |
| Examination and completion of forms | 89.1 | .92 | 69.1 | .70 | 98.1 | .99 | 76.5 | .77 | 93.5 | .94 | 99.1 | .99 | 80.0 | .81 | 72.9 | .73 | 88.9 | .90 |
| Prophylaxis, including scaling and polishing | 86.2 | .90 | 61.5 | .62 | 76.5 | .81 | 57.7 | .58 | 47.2 | .48 | 27.6 | .28 | 48.8 | .49 | 44.2 | .44 | 58.7 | .60 |
| Full mouth roentgenogram | 54.9 | .55 | 25.1 | .25 | 56.7 | .58 | 29.8 | .30 | 5.0 | .05 | 12.0 | .12 | 15.0 | .15 | 13.8 | .14 | 30.8 | .31 |
| Bitewing roentgenogram | 39.6 | .41 | 35.0 | .35 | 52.3 | .54 | 37.4 | .39 | 67.7 | 1.60 | 83.1 | .83 | 70.0 | .73 | 50.0 | .53 | 54.9 | .70 |
| Single roentgenogram | 16.3 | .38 | 21.2 | .66 | 39.7 | .90 | 26.2 | .90 | 13.7 | .34 | 15.6 | .33 | 18.8 | .38 | 19.1 | .54 | 22.2 | .56 |
| One-surface amalgam filling | 64.4 | 2.59 | 69.7 | 2.36 | 59.0 | 2.37 | 58.4 | 1.63 | 70.6 | 2.52 | 68.6 | 2.39 | 63.8 | 1.89 | 64.7 | 2.12 | 65.2 | 2.35 |
| Two-surface amalgam filling | 66.4 | 2.54 | 57.8 | 1.69 | 54.4 | 1.82 | 50.7 | 1.31 | 68.5 | 2.26 | 70.7 | 2.38 | 58.8 | 1.58 | 55.6 | 1.44 | 61.9 | 2.03 |
| Three-surface amalgam filling | 29.7 | .49 | 20.9 | .37 | 20.1 | .30 | 12.5 | .20 | 28.4 | .63 | 36.9 | .86 | 22.5 | .50 | 17.6 | .32 | 25.5 | .50 |
| Four-surface amalgam filling | 11.0 | .15 | .1 | — | .7 | .01 | .0 | .00 | 1.7 | .02 | 4.0 | .06 | .0 | .00 | .0 | .00 | 3.1 | .04 |
| One-surface acrylic filling | 1.5 | .04 | 1.9 | .05 | 1.6 | .03 | 2.2 | .03 | 1.2 | .02 | 8.4 | .35 | 3.8 | .09 | 1.6 | .03 | 2.9 | .10 |
| Two-surface acrylic filling | .6 | .01 | .0 | .00 | .1 | — | .0 | .00 | .1 | — | 1.4 | .02 | .0 | .00 | .2 | — | .4 | .01 |
| One-surface silicate filling | 15.1 | .51 | 15.9 | .44 | 6.2 | .18 | 3.6 | .09 | 20.7 | .72 | 14.6 | .59 | 10.0 | .30 | 11.6 | .37 | 12.9 | .43 |
| Two-surface silicate filling | .7 | .01 | .4 | .01 | .0 | .00 | .1 | — | 2.2 | .05 | .4 | .01 | 1.3 | .01 | .0 | .00 | .6 | .01 |
| One-surface temporary filling | .0 | .00 | 1.0 | .02 | 16.5 | .30 | 1.7 | .03 | .3 | .01 | .1 | — | .0 | .00 | .7 | .01 | 3.7 | .07 |
| Two-surface temporary filling | .1 | — | .1 | — | 8.8 | .13 | .4 | .01 | .1 | — | .0 | .00 | 1.3 | .01 | .0 | .00 | 1.9 | .03 |
| Three-surface temporary filling | .0 | .00 | .1 | — | 2.8 | .04 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .6 | .01 |
| Permanent crown | 1.7 | .03 | .8 | .01 | 2.7 | .05 | 1.2 | .02 | 1.3 | .02 | 1.5 | .02 | .0 | .00 | .4 | — | 1.6 | .03 |
| Temporary crown | .7 | .01 | .4 | .01 | 1.2 | .02 | .7 | .01 | .9 | .02 | 1.8 | .03 | .0 | .00 | 1.8 | .38 | 1.0 | .02 |
| Partial denture | 1.6 | .03 | .2 | — | .6 | .01 | .0 | .00 | .4 | .01 | .4 | — | 1.3 | .01 | .0 | .00 | .6 | .01 |
| Space maintainer | 14.5 | .20 | 2.5 | .03 | 8.5 | .11 | 2.5 | .03 | .1 | — | .1 | — | 1.3 | .01 | 1.8 | .02 | 4.9 | .06 |
| Study models | .0 | .00 | .1 | — | 12.4 | .13 | .3 | — | .0 | .00 | .0 | .00 | .0 | .00 | .2 | — | 2.6 | .03 |
| Denture adjustment | 7.4 | .17 | .2 | — | 2.9 | .06 | .1 | — | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | 1.9 | .04 |
| Denture repairs | 3.0 | .04 | .0 | .00 | 1.1 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .7 | .01 |
| Sodium fluoride treatment | 2.4 | .07 | 6.1 | .19 | 1.5 | .05 | 12.4 | .28 | 16.0 | .64 | 17.0 | .67 | 18.8 | .75 | 6.0 | .23 | 8.8 | .32 |
| Periodontal treatment | .5 | .01 | .2 | — | 1.0 | .02 | 1.0 | .02 | .2 | — | .0 | .00 | .0 | .00 | .7 | .01 | .4 | .01 |
| Pulp cap | 10.6 | .14 | 4.6 | .08 | 8.3 | .12 | 1.2 | .02 | 6.0 | .09 | 7.0 | .14 | 6.3 | .10 | 3.1 | .04 | 6.7 | .10 |
| Therapeutic pulpotomy | .4 | — | 1.8 | .03 | 2.5 | .03 | .3 | — | .4 | .01 | .1 | — | .0 | .00 | 1.6 | .02 | 1.0 | .01 |
| Vital pulpotomy | 12.1 | .18 | 1.6 | .02 | 3.2 | .04 | 3.5 | .05 | 1.0 | .02 | 3.2 | .06 | 1.3 | .25 | 4.0 | .08 | 4.3 | .06 |
| Extirpation of pulp | 1.0 | .01 | .6 | .01 | .7 | .01 | .3 | — | .2 | — | .7 | .01 | .0 | .00 | 1.1 | .01 | .7 | .01 |
| Simple extraction | 34.1 | .72 | 24.8 | .58 | 23.1 | .46 | 13.2 | .26 | 26.4 | .64 | 30.5 | .81 | 25.0 | .61 | 24.7 | .65 | 26.4 | .61 |
| Complex extraction | .3 | — | .2 | — | .7 | .01 | .4 | .01 | .3 | — | .4 | .01 | .0 | .00 | .4 | .01 | .4 | .01 |
| Other surgical procedure | .4 | .01 | .3 | — | .6 | .01 | .2 | — | .3 | .01 | .3 | — | 1.3 | .01 | .2 | — | .4 | .01 |
| Broken appointment | 57.3 | 1.19 | 3.7 | .05 | 42.1 | .77 | 4.5 | .07 | 6.2 | .09 | 2.3 | .04 | .0 | .00 | 7.6 | .12 | 21.2 | .40 |
| Behavior problem | 2.9 | .04 | .2 | — | 1.9 | .02 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .9 | .01 |
| Anesthetic | .0 | .00 | 2.3 | .04 | 1.0 | .01 | 1.0 | .01 | 1.0 | .01 | .5 | .01 | .0 | .00 | 1.8 | .02 | .9 | .01 |
| Penicillin | .3 | .01 | .5 | .01 | .3 | — | .0 | .00 | .4 | .01 | .1 | — | .0 | .00 | .2 | — | .3 | — |
| Unclassified | .0 | .00 | .1 | — | 4.0 | .05 | .4 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .4 | .01 | .9 | .01 |

**Table 20** • Dental services received in recall episodes, for eight of the nine plans

| Service | San Francisco Service | | San Francisco Insured | | Wilmington Service | | Wilmington Insured | | Oregon Service | | Washington Service | | Washington Insured | | California Small Ports Insured | | All plans | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. | % | Avg. |
| Examination and completion of forms | 84.7 | .86 | 31.2 | .32 | 91.7 | .94 | 36.2 | .37 | 70.7 | .80 | 99.4 | .99 | 40.0 | .40 | 52.5 | .53 | 79.2 | .82 |
| Prophylaxis, including scaling and polishing | 76.7 | .79 | 63.1 | .68 | 14.3 | .14 | 61.6 | .70 | 51.9 | .59 | 25.1 | .25 | 53.3 | .60 | 62.3 | .67 | 40.7 | .44 |
| Full mouth roentgenogram | 8.0 | .08 | 6.4 | .06 | 30.0 | .30 | 3.2 | .03 | 1.1 | .01 | .6 | .01 | 13.3 | .13 | 6.6 | .07 | 9.4 | .09 |
| Bitewing roentgenogram | 80.7 | .82 | 29.3 | .31 | 54.0 | .56 | 44.9 | .52 | 55.7 | 1.32 | 58.7 | .59 | 60.0 | .67 | 54.1 | .56 | 56.6 | .74 |
| Single roentgenogram | 5.6 | .09 | 12.7 | .38 | 35.5 | .55 | 21.1 | .73 | 7.0 | .15 | 4.2 | .08 | 13.3 | .27 | 9.8 | .25 | 14.4 | .28 |
| One-surface amalgam filling | 23.6 | .41 | 49.0 | 1.01 | 21.8 | .55 | 34.6 | .71 | 51.0 | 1.18 | 38.8 | .91 | 66.7 | 1.33 | 32.8 | .75 | 36.0 | .81 |
| Two-surface amalgam filling | 28.6 | .59 | 21.7 | .40 | 21.7 | .47 | 16.2 | .26 | 43.7 | .94 | 29.6 | .55 | 46.7 | 1.07 | 39.3 | 1.08 | 29.4 | .60 |
| Three-surface amalgam filling | 5.3 | .06 | 6.4 | .08 | 4.2 | .05 | 2.2 | .02 | 7.6 | .11 | 6.6 | .11 | 6.7 | .13 | 11.5 | .15 | 5.8 | .10 |
| Four-surface amalgam filling | .7 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .2 | — | .2 | — | .0 | .00 | .0 | .00 | .2 | — |
| One-surface acrylic filling | .3 | .01 | .0 | .00 | .7 | .01 | .0 | .00 | 1.7 | .03 | 1.8 | .04 | 6.7 | .13 | 3.3 | .05 | 1.2 | .02 |
| Two-surface acrylic filling | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .3 | — | .0 | .00 | .0 | .00 | .1 | — |
| One-surface silicate filling | 5.0 | .11 | 6.4 | .15 | .8 | .01 | 1.1 | .02 | 13.3 | .29 | 7.6 | .19 | 13.3 | .20 | 4.9 | .25 | 6.2 | .14 |
| Two-surface silicate filling | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .8 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .2 | — |
| One-surface temporary filling | .0 | .00 | .0 | .00 | 3.0 | .05 | 1.6 | .03 | .0 | .00 | .2 | — | .0 | .00 | 3.3 | .05 | 1.0 | .02 |
| Two-surface temporary filling | .0 | .00 | .0 | .00 | .8 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .2 | — |
| Three-surface temporary filling | .0 | .00 | .0 | .00 | .3 | — | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .1 | — |
| Permanent crown | .0 | .00 | .0 | .00 | .5 | .01 | .5 | .01 | 1.0 | .02 | .5 | .01 | .0 | .00 | .0 | .00 | .5 | .01 |
| Temporary crown | .0 | .00 | .0 | .00 | .5 | .01 | .5 | .01 | .4 | .01 | .2 | — | .0 | .00 | .0 | .00 | .3 | — |
| Partial denture | .1 | .04 | .0 | .00 | .0 | .00 | .0 | .00 | .4 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .2 | .01 |
| Space maintainer | 7.3 | .08 | .0 | .00 | 1.2 | .02 | .5 | .01 | .2 | .01 | .0 | .00 | .0 | .00 | 4.9 | .05 | 1.4 | .02 |
| Study models | .0 | .00 | .0 | .00 | 2.7 | .03 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .6 | .01 |
| Denture adjustment | 11.0 | .21 | .0 | .00 | 1.3 | .02 | .5 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | 1.7 | .03 |
| Denture repairs | 5.0 | .07 | .0 | .00 | .8 | .01 | .0 | .00 | .2 | — | .0 | .00 | .0 | .00 | .0 | .00 | .8 | .01 |
| Sodium fluoride treatment | 7.3 | .25 | 3.2 | .07 | 73.8 | 2.64 | 15.1 | .26 | 11.6 | .46 | 5.2 | .21 | 6.7 | .27 | 9.8 | .25 | 24.0 | .85 |
| Periodontal treatment | .0 | .00 | .0 | .00 | .2 | — | 1.1 | .01 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .1 | — |
| Pulp cap | .7 | .01 | .0 | .00 | .8 | .01 | .5 | .01 | 1.0 | .02 | .5 | .01 | 6.7 | .07 | 3.3 | .08 | .8 | .01 |
| Therapeutic pulpotomy | .0 | .00 | .6 | .01 | .2 | — | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .1 | — |
| Vital pulpotomy | .0 | .00 | .6 | .01 | .2 | — | .0 | .00 | .2 | — | .6 | .01 | .0 | .00 | .0 | .00 | .3 | — |
| Extirpation of pulp | .3 | — | .0 | .00 | .2 | — | .0 | .00 | .2 | — | .0 | .00 | .0 | .00 | .0 | .00 | .1 | — |
| Simple extraction | 5.0 | .06 | 10.8 | .18 | 6.2 | .12 | 11.4 | .15 | 9.5 | .14 | 4.0 | .06 | .0 | .00 | 4.9 | .10 | 6.7 | .11 |
| Complex extraction | .0 | .00 | .0 | .00 | .0 | .00 | .5 | .01 | .2 | — | .0 | .00 | .0 | .00 | .0 | .00 | .1 | — |
| Other surgical procedure | .0 | .00 | .0 | .00 | .3 | — | .0 | .00 | .2 | — | .2 | .01 | .0 | .00 | .0 | .00 | .2 | — |
| Broken appointment | 26.6 | .40 | .6 | .01 | 23.2 | .32 | 2.2 | .02 | 3.2 | .04 | .5 | .01 | .0 | .00 | 3.3 | .05 | 9.8 | .14 |
| Behavior problem | .0 | .00 | .0 | .00 | 3.8 | .04 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .9 | .01 |
| Anesthetic | .0 | .00 | 1.3 | .03 | .5 | .01 | .5 | .01 | .8 | .01 | .3 | — | .0 | .00 | .0 | .00 | .4 | .01 |
| Penicillin | .0 | .00 | .0 | .00 | .2 | — | .0 | .00 | .0 | .00 | .2 | — | .0 | .00 | .0 | .00 | .1 | — |
| Unclassified | .0 | .00 | .0 | .00 | 4.0 | .04 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | .0 | .00 | 1.0 | .01 |

five times as large a proportion as any other plan.

Broken appointments in the initial series were reported for about half of the patients in the two California service plans, both of which were clinics. In all other plans combined, only about 4 per cent of the patients broke appointments. In the recall series, these figures were cut approximately in half.

A summary measure of the amount of service provided per patient in each plan may be obtained by adding the figures in the "Avg." column in Tables 19 and 20 to obtain the total number of services per child. Of course, this measure is not precise because some services require more dentist time than others. No record was made of the amount of chair time that was required for patients in the program.

In the initial episodes, each service plan ranked above all insured plans in number of services provided per patient (services in this context include broken appointments and behavior problems). The service plans ranked as follows: (1) San Francisco (12.36); (2) Oregon (11.21); (3) Washington (11.01) and (4) Wilmington (10.99). The insured plans ranked as follows: (1) Washington (8.68); (2) San Francisco (8.58); (3) California small ports (8.27) and (4) Wilmington (7.03).

Another measure of the total amount of dental service provided per child will be the cost figures to be presented in the next chapter in this series.

BUREAU OF LIBRARY AND INDEXING SERVICE

# American Dental Association Film Library

The following films have been added to the film collection and are available for a service charge of $2.50 from the Film Library:

## FILM REVIEWS

*Correlation of Structure and Function of the Temporomandibular Joint* • 16 mm., magnetic sound, color, 33 minutes. Produced in 1955 by Joseph S. Landa, D.D.S., 136 E. 54 St., New York 22. Rental $2.50. Producer may be contacted for purchase.

The film is a study of the masticatory mechanism. The first part shows a dissection of the masseter muscle, the parotid gland and the pterygoid muscle on a wet specimen. The second part is a cinefluorographic study of the rotation, translation and movement of the temporomandibular joint and the physiology of mastication. The soft palate is shown to contact the posterior wall of the pharynx at a much higher point than was believed before the advent of cinefluorography. The film is well presented and suitable for teaching, information and research.

*Endodontics and Apicurettage—Mandibular Anterior Area* • 16 mm., silent, color, 30 minutes. Produced in 1956, revised in 1957, by David Green, D.D.S., 1 Hanson Place, Brooklyn 17, N. Y. Rental $2.50. Producer may be contacted for purchase. Distribution limited.

A procedure in endodontics that reduces armamentarium and medication to a minimum. After the preparation and obturation of the canal, an oblique flap is raised to give access to the periapical area. After apicurettage the wound is sutured. Postoperative examinations show complete bone regeneration in the operative area.

*Immediate Full Upper Dentures Without Lip Protrusion* • 16 mm., sound, color, 20 minutes. Produced in 1957 by Henry Rohrer, D.D.S.,

636 Sibley Tower Bldg., Rochester 4, N. Y. Rental $2.50. Producer may be contacted for purchase.

The film demonstrates the impression technic, laboratory procedures and surgery necessary to produce an immediate upper denture with a labial flange without lip protrusion. Anterior teeth are removed alternately from model and denture teeth are set up without using wax over the labial portion of the model. An alveolectomy is done on the model to the depth of the flange of the denture. In surgery, the teeth are removed and the denture is given a try-in before tissues are coated and sutured. The alveolectomy on the patient is not shown. Postoperative conditions are illustrated.

*Removal of Root Fragments* • 16 mm., magnetic sound, color, 28 minutes. Produced in 1957 by the University of Minnesota School of Dentistry. Rental $2.50. Producer may be contacted for purchase.

The film demonstrates the usual methods for removing roots which have been fractured during removal of teeth and the technics for recovery of retained root tips discovered on routine roentgenographic examinations. Seven representative instances are demonstrated on patients. Both upper and lower jaw situations are shown. A flap procedure is demonstrated.

*A Technique for Locating and Recording a Hinge Axis* • 16 mm., sound, color, 10 minutes. Produced in 1957 by Martin Entine, D.D.S., 3037 N. Broad St., Philadelphia 32. Rental $2.50. Producer may be contacted for purchase.

A demonstration of the theory behind hinge axis and the recording of a hinge axis with the use of a hinge bow. An animated model is used for the explanation of theory and armamentarium. The placement of the clutches, the attachment of the bows, and the use of a mirror and pin for locating the hinge axis are demonstrated on a patient. A tattoo is used for permanent marking of the hinge points.

## Additions to the Library

The books listed here have been added recently to the Library collection. Requests for this material, available on loan to all members of the Association, should be addressed to the Bureau of Library and Indexing Service. There is no charge for borrowing books, but there is a minimal charge of fifty cents for package libraries. Most of these books may be purchased also through the Bureau. Practically all the dental journals published in the world at present are available also to members on loan. Lists of books and package libraries are also available on request.

BOOKS

AMERICAN COLLEGE OF DENTISTS. A guide to professional conduct. St. Louis, 1958. 12 p.

AMERICAN DENTAL ASSOCIATION. Statement on dentifrice advertising claims before Subcommittee on Legal and Monetary Affairs of the Committee on Government Operations, House of Representatives, July 17, 1958. Chicago, 1958. 49 p. Mimeo.

ASSOCIATION OF TEACHERS OF PREVENTIVE MEDICINE. COMMITTEE OF MEDICAL CARE TEACHING. Readings in medical care. Chapel Hill, Univ. of North Carolina Press, 1958. 708 p. $6.50.

BENEDICT, E. B. & NARDI, G. L. The esophagus; medical and surgical management. Boston, Little, Brown, 1958. 390 p. $15.

BERLOVE, I. J. The gateway to health; interrelationship of the mouth, teeth and body. New York, Whittier Books, 1958. 148 p. $3.50.

BLASS, J. L. Motivating patients for more effective dental service. Philadelphia, Lippincott, 1958. 176 p. $6.50.

BREDOW, MIRIAM. The medical assistant; a guidebook for the nurse, secretary, and technician in the doctor's office. New York, Blakiston Division, 1958. 430 p. $7.50.

BRITISH DENTAL ASSOCIATION. Memorandum on dental research in the United Kingdom. London, 1958. 35 p.

CAMPBELL, J. MENZIES. From a trade to a profession; byways in dental history. Glasgow, 1958. 254 p. For private circulation.

COHEN, R. A. The history of the Birmingham Dental Hospital and Dental School 1858-

1958. Birmingham, Board of Governors of the United Birmingham Hospitals, 1958. 40 p.

COOLIDGE, E. D. & HINE, M. K. Periodontology; clinical pathology and treatment of the periodontal tissues. 3d ed. Philadelphia, Lea & Febiger, 1958. 440 p. $8.50.

DENTAL CLINICS OF NORTH AMERICA, July 1958. Symposium on the interrelationship of oral and systemic disease. Philadelphia, Saunders, 1958. 266 p.

DEUTSCHER ZAHNÄRZTEKALENDER 1958. Vol. 17, edited by Ewald Harndt. Munich, Hanser, 1957. 411 p. DM14.

EBLING, HARDY. Inervação do periodonto do incisivo inferior do rato. Thesis Univ. do Rio Grande do Sul. Pôrto Alegre, 1957. 36 p.

ELWELL, K. B. & EASLICK, K. A. Classification and appraisal of objections to fluoridation. Ann Arbor, Univ. of Michigan, 1957. 149 p. Mimeo.

GRUMBACH, ARTHUR & KIKUTH, WALTER. Die Infektionskrankheiten des Menschen und ihre Erreger. Stuttgart, Thieme, 1958. 2 v. DM198.

ILLINOIS. UNIVERSITY. COLLEGE OF DENTISTRY. Current advances in dentistry 1956-1957; a manual of the ninth telephone extension program. Edited by Saul Levy. Urbana, Univ. of Illinois Press, 1956. 113 p. $2.80.

KETTERING LABORATORY. CINCINNATI. The occurrence and biological effects of fluorine compounds; annotated bibliography. Vol. 1, pt. 1: inorganic compounds. Prepared by Irene R. Campbell and Evelyn M. Widner, with the assistance of Irene P. Kukainis. Cincinnati, 1958. 507 p.

MASSLER, MAURY & SCHOUR, ISAAC. Atlas of the mouth in health and disease. Drawings by Carl T. Linden. 2d ed. Chicago, American Dental Association, 1958. 67 plates. $5.

MORLEY, M. E. Cleft palate and speech. Edinburgh, Livingstone, 1958. 271 p. $6.50.

NATIONAL HEMOPHILIA FOUNDATION. Hemophilia and hemophilioid diseases; international symposium held at the Ambassador Hotel, New York City, August 24-25, 1956. Editor: Kenneth M. Brinkhous. Chapel Hill, Univ. of North Carolina Press, 1957. 265 p. $7.50.

NEW YORK STATE UNIVERSITY & STATE EDUCATION DEPARTMENT. Dentistry, including dental hygiene; law, rules and information. (Professional education handbook 10.) Albany, 1957. 106 p.

SHAFER, W. G.; HINE, M. K. & LEVY, B. M. A textbook of oral pathology. Philadelphia, Saunders, 1958. 714 p. $16.50.

SLACK, G. L. A world survey of the teaching methods in children's dentistry. Liverpool, 1957. 94 p. 6 shillings.

SOMMER, R. F.; OSTRANDER, F. D. & CROWLEY, M. C. Endodoncia clínica; manual de endodoncia científica. Traducción por el Hernán A. Coscolla. Buenos Aires, Editorial Mundi, 1958. 644 p.

TENNESSEE STATE DENTAL ASSOCIATION. History of the Tennessee State Dental Association. Compiled by Thomas Davidson Dow, written by Madison Jones. Nashville, 1958. 300 p.

WAAS, M. J. As it waas. Philadelphia, Dorrance & Company, 1957. 125 p. $2.50.

WORLD HEALTH ORGANIZATION. The first ten years of the World Health Organization. Geneva, 1958. 538 p. $5.

WORLD HEALTH ORGANIZATION. EXPERT COMMITTEE ON WATER FLUORIDATION. First report. (Technical report series No. 146.) Geneva, 1958. 25 p. $0.30.

WRIGHT, H. B. Witness to witchcraft. New York, Funk & Wagnalls, 1957. 246 p. $3.95.

# *Deaths*

Angelo, Stuart M., Arlington, Va.; George Washington University Dental Department, 1912; died April 11; age 69.

Backowske, Michael L., Fort Harrison, Mont.; North Pacific College of Oregon School of Dentistry, 1924; died April 26; age 58.

Baker, Francis E., Oklahoma City; Baylor University College of Dentistry, 1950; died May 12; age 38.

Barber, Willis A., Springfield, Ohio; Ohio Medical University College of Dentistry, 1900; died February 20; age 85.

Barclay, Harry F., Peoria, Ill.; Chicago College of Dental Surgery, 1916; died March 21; age 74.

Brandhorst, Arnold W., Alton, Ill.; Washington University School of Dentistry, St. Louis, 1929; died April 22; age 54.

Barner, William M., Columbus, Ga.; Atlanta Dental College, 1924; died April 30; age 78.

Beam, Calvin M., Ashville, N. C.; Atlanta Dental College, 1905; died May 24; age 75.

Bergh, Charles J., Havertown, Pa.; University of Minnesota School of Dentistry, 1908; died March 27; age 74.

Bergman, Samuel E., Los Angeles; University of Southern California School of Dentistry, 1925; died May 19; age 59.

Berthel, Russell, W., St. Paul; Pennsylvania College of Dental Surgery, 1890; died April 28; age 91.

Bohn, Edward W., Reading, Pa.; University of Pennsylvania School of Dentistry, 1897; died May 20; age 82.

Booth, John J., Marion, Iowa; University of Iowa College of Dentistry, 1899; died May 26; age 80.

Botthoff, John L., Houston, Texas; Texas Dental College, 1926; died January 17; age 66.

Branch, J. F., Cleveland; Ohio College of Dental Surgery, University of Cincinnati, 1923; died March 21; age 60.

Breslow, David, Brooklyn; College of Dental and Oral Surgery, New York, 1919; died April 22; age 58.

Brown, Ernest A., Scottsburg, Ind.; Indiana University School of Dentistry, 1938; died April 22; age 51.

Brown, Henry, Seattle; Chicago College of Dental Surgery, 1897; died March 18; age 84.

Brown, John H., Oklahoma City, Okla.; Missouri Dental College, 1901; died February 24; age 79.

Buck, Walter L., East St. Louis, Ill.; Washington University School of Dentistry, St. Louis, 1918; died May 5; age 62.

Buehren, William J. C., San Jose, Calif.; University of Southern California School of Dentistry, 1918; died April 20; age 65.

Bundy, Richard F., Little Compton, R. I.; Baltimore College of Dental Surgery, 1916; died April 25; age 69.

Byrne, George C., Belleville, N. J.; Pennsylvania College of Dental Surgery, 1897; died May 20; age 83.

Carroll, Dean M., Beverly Hills, Calif.; University of Southern California School of Dentistry, 1927; died May 12; age 63.

Chapin, Willard F., Clyde, Ohio; Western Reserve University School of Dentistry, 1901; died May 18; age 80.

Chase, Carlos D., Rochester, N. Y.; University of Buffalo School of Dentistry, 1906; died April 24; age 74.

Childs, Frank A., Lyons, Kan.; Western Dental College, 1908; died April 2; age 73.

Clow, L. Parks, Centerville, Iowa; University of Iowa College of Dentistry, 1910; died April 3; age 76.

Clune, Thomas W., Cranston, R. I.; Tufts College Dental School, 1931; died May 2; age 52.

Cobb, Samuel B., Fort Worth, Texas; Atlanta Dental College, 1898; died March 25; age 81.

Cole, Oscar H., St. Paul; Chicago College of Dental Surgery, 1898; died May 11; age 84.

Collins, Francis, Minneapolis; University of Minnesota School of Dentistry, 1925; died March 26; age 55.

Conley, Henry Q., Evanston, Ill.; Northwestern University Dental School, 1934; died April 26; age 47.

Cook, Dexter A., New York; died May 13; age 80.

Cook, Edward C., Ringgold, La.; Atlanta Dental College, 1913; died April 2; age 74.

Cress, George H., Grand Junction, Iowa; University of Iowa College of Dentistry, 1902; died May 22; age 80.

Crites, Llewellyn L., Marshfield, Mass.; Tufts College Dental School, 1917; died April 24; age 63.

Cronan, Charles A., Milford, Mass.; Tufts

College Dental School, 1901; died May 1; age 77.

Cutler, Roswell S., Moorcraft, Wyo.; Creighton University College of Dentistry, 1910; died May 13; age 73.

Dauterive, Albert J., Breaux Bridge, La.; Northwestern University Dental School, 1903; died January 28; age 80.

Davenport, Sebert E., Jr., New York; Harvard Dental School, 1910; died May 26; age 69.

Davis, Joseph Vernon, Winston-Salem, N. C.; Baltimore College of Dental Surgery, 1908; died April 4; age 71.

Decker, Duard L., San Antonio, Texas; Texas Dental College, 1922; died January 30; age 73.

Dikselis, Anthony J., Chicago; Indiana Dental College, 1923; died February 28; age 73.

Dippel, John R., Milwaukee; Wisconsin College of Physicians and Surgeons Department of Dental Surgery, 1905; died May 29; age 84.

Distel, William E., St. Paul; University of Minnesota School of Dentistry, 1915; died May 19; age 66.

Doerr, Harry, St. Louis; St. Louis University School of Dentistry, 1926; died April 21; age 63.

Dolan, Joseph K., Pawtucket, R. I.; Baltimore College of Dental Surgery, 1926; died April 27; age 58.

Dorfner, Walter S., Tacoma, Wash.; North Pacific College of Oregon School of Dentistry, 1905; died March 29; age 73.

Drespel Harry, Brooklyn; New York College of Dentistry, 1917; died May 24; age 67.

Druckaroff, Alter I., Chicago; Chicago College of Dental Surgery, 1921; died May 25; age 61.

Dudley, Frederick B., New York; University of Buffalo School of Dentistry, 1902; died May 15; age 80.

Dyer, James D., Kansas City, Mo.; Kansas City Dental College, 1916; died April 18; age 71.

Eakin, Stanley W., New York; Ohio Medical University College of Dentistry, 1900; died January 4; age 81.

Edens, John Q., Clearwater, Kan.; Temple University School of Dentistry, 1908; died May 5; age 80.

Ellington, Rex T., Gunnison, Colo.; University of Denver School of Dentistry, 1918; died April 24; age 60.

Ewing, Frank S., Smiths Grove, Ky.; Louisville College of Dentistry, 1908; died April 10; age 71.

Fairchild, Victor M., Olean, N. Y.; University of Buffalo School of Dentistry, 1917; died April 27; age 63.

Fenton, Maurice J., Brookville, L. I., N. Y.; Tufts College Dental School, 1919; died April 15; age 62.

Fisher, Leonard P., Ann Arbor, Mich.; University of Michigan School of Dentistry, 1916; died June 1; age 65.

Fordyce, James A., Verona, Pa.; University of Pittsburgh School of Dentistry, 1910; died May 19; age 71.

Frisbie, Josephine M., San Francisco; University of California College of Dentistry, 1924; died December 31, 1957; age 56.

Gale, Lawrence M., Orlando, Fla.; Ohio State University College of Dentistry, 1916; died April 29; age 63.

Garretson, Jack C., Seattle; Northwestern University Dental School, 1943; died May 16; age 40.

Gerend, Alban H., Sheboygan, Wis.; Marquette University Dental School, 1925; died May 8; age 57.

Gilch, George F., Medford, Mass.; Georgetown University School of Dentistry, 1915; died May 18; age 65.

Goloven, Alex, St. Paul; Chicago College of Dental Surgery, 1914; died April 20; age 67.

Gordon, Harry A., Wooster, Ohio; New York College of Dentistry, 1910; died April 26; age 69.

Gorsuch, Bateson, Delaware, Ohio; Ohio Medical College of Dentistry, 1905; died May 13; age 86.

Goss, Frank S., Spencerville, Ohio; Ohio Medical University College of Dentistry, 1903; died April 10; age 82.

Grabski, Alexis J., Cleveland, Ohio; Western Reserve University School of Dentistry, 1919; died April 16; age 63.

Graham, Edward B., Miami, Fla.; College of Dental and Oral Surgery, New York, 1915; died May 21; age 63.

Groseclose, James H., Jr., Dallas, Texas; Baylor University College of Dentistry, 1927; died April 25; age 55.

Gross, Benjamin, Hartford, Conn.; Baltimore College of Dental Surgery, 1914; died May 6; age 67.

Grove, Burnam O., Roanoke, Va.; Medical College of Virginia Dental Department, 1905; died April 17; age 77.

Halbauer, Stewart E., Terrace Park, Ohio; Cincinnati College of Dental Surgery, 1928; died April 30; age 52.

Hancock, Harry R., Santa Barbara, Calif.; University of Southern California School of Dentistry, 1924; died April 27; age 66.

Hankins, Elton E., Jr., Los Angeles; University of Southern California School of Dentistry, 1926; died May 23; age 57.

Harper, Dallas L., Coffeyville, Kan.; Kansas City-Western Dental College, 1925; died April 11; age 59.

Harrington, Arthur W., Adams, Mass.; University of Pennsylvania School of Dentistry, 1918; died May 25; age 63.

Harris, Manville S., Rochester, N. Y.; University of Pennsylvania School of Dentistry, 1917; died April 21; age 61.

Heisler, John C., Jefferson City, Mo.; Northwestern University Dental School, 1918; died April 24; age 65.

Heupel, Robert G., Phoenix, Ariz.; Loyola University School of Dentistry, Chicago College of Dental Surgery, 1931; died May 20; age 51.

Hickey, William T., Daytona Beach, Fla.; Northwestern University Dental School, 1947; died April 2; age 38.

Hickman, Fred M., Indianapolis; died April 17; age 72.

Hill, George W., Zanesville, Ohio; Ohio State University College of Dentistry, 1916; died April 10; age 64.

Hilliard, Lloyd B., Redlands, Calif.; University of Southern California School of Dentistry, 1925; died June 2; age 56.

Hirn, Frederick J., Escanaba, Mich.; Northwestern University Dental School, 1914; died May 25; age 66.

Hoffman, Sidney C., Orleans, Ind.; Indiana Dental College, 1917; died May 6; age 66.

Holden, Frederick A., Haverhill, Mass.; Boston Dental College, 1897; died April 24; age 84.

Hopping, John G., Birmingham, Ala.; Birmingham Dental College, 1901; died May 30; age 87.

Horton, Albert P., Dallas, Texas; University of Buffalo School of Dentistry, 1914; died May 14; age 65.

Hottenstein, Charles A., Kutztown, Pa.; Pennsylvania College of Dental Surgery, 1892; died April 8; age 86.

Howland, Thomas A., Decatur, Ill.; Loyola University School of Dentistry, Chicago College of Dental Surgery, 1927; died April 26; age 56.

Hubbard, Boyd, Hollywood, Calif.; died May 7; age 88.

Huber, Theodore, Webster, S. D.; died February 27; age 81.

Hunt, Edward D., Mount Victory, Ohio; died May 7; age 88.

Hutchison, Charles L., Scotland Neck, N. C.; Baltimore College of Dental Surgery, 1909; died April 12; age 73.

Ioset, Ray G., Twin Falls, Idaho; University of Minnesota School of Dentistry, 1920; died May 4; age 62.

Jasielum, Michael C., Pleasant City, Ohio; Baltimore Medical College, Dental Department, 1901; died January 23; age 77.

Jones, Charles E., Port Washington, N. Y.; died April 14; age 63.

Kamin, Max J., Brooklyn; New York University College of Dentistry, 1934; died May 23; age 48.

Kaparich, John J., Butte, Mont.; Marquette University Dental School, 1944; died April 11; age 38.

Kelly, William C., Rebersburg, Pa.; University of Pennsylvania School of Dentistry, 1910; died April 29; age 74.

Kestly, Fred C., Antigo, Wis.; Northwestern University Dental School, 1899; died April 30; age 86.

King, Daniel L., Huntingdon, Tenn.; Vanderbilt University School of Dentistry, 1904; died May 19; age 86.

King, James A., McConnelsville, Ohio; died May 13; age 88.

Klump, Charles F., Cincinnati, Ohio; Detroit College of Medicine, Department of Dental Surgery, 1907; died May 25.

Knapp, Karl W., New York; University of Iowa College of Dentistry, 1906; died April 26; age 72.

Koempel, John A., New York; New York College of Dentistry, 1908; died May 7; age 75.

Kosanke, Edward J., Harbor Beach, Mich.; University of Michigan School of Dentistry, 1913; died April 30; age 68.

Kral, Theodore S., Chicago; Northwestern University Dental School, 1909; died May 4; age 71.

Krumbiegel, Charles E., Minneapolis; University of Minnesota School of Dentistry, 1935; died May 10; age 48.

Lackner, William S., Tucson, Ariz.; Royal College of Dental Surgeons School of Dentistry, Toronto, Ontario, Canada, 1911; died May 17; age 69.

Largent, Raymond A., McKinney, Texas; Chicago College of Dental Surgery, 1907; died February 9; age 71.

Laue, Robert H., River Falls, Wis.; Marquette University Dental School, 1913; died February 27; age 69.

Laville, Louis Parkerson, Plaquemine, La.; Loyola University School of Dentistry, New Orleans, 1919; died April 17; age 61.

Lazarus, Louis, New York; New York College of Dentistry, 1919; died May 4; age 64.

Leach, Troy A., Hutchinson, Kan.; Omaha Dental College, 1904; died April 2; age 78.

Less, Robert, New York; Howard University College of Dentistry, 1950; died April 7; age 62.

Leveron, James R., East Gary, Ind.; Indiana Dental College, 1916; died March 31; age 64.

Leviash, Harry D., Milwaukee; Marquette University Dental School, 1919; died April 18; age 61.

Linder, J. Victor, Banner Elk, N. C.; Chicago College of Dental Surgery, 1919; died April 28.

Linn, Wallace T., Waveland, Ind.; Central College of Dentistry, Indianapolis, 1904; died May 30; age 80.

Martin, Loren, Salem, Ind.; Indiana Dental College, 1915; died February 6; age 65.

Lorio, Alvin B., Baton Rouge, La.; Tulane University School of Dentistry, 1927; died May 29; age 54.

Love, James H., Albuquerque, N. M.; died March 1; age 53.

Lucas, Stanislaus J., Detroit; Royal College of Dental Surgery School of Dentistry, Toronto, Ontario, Canada, 1924; died April 26; age 56.

Marshall, Edwin, Chicago; died April 11.

Martin, Albert E., Coffeyville, Kan.; Western Dental College, 1906; died March 12; age 77.

Martin, Ernest L., Charleston, W. Va.; Louisville College of Dentistry, 1914; died January 30; age 71.

Martin, Thomas Waldo, New York; College of Dental and Oral Surgery, New York, 1915; died April 15; age 64.

Matthews, Oscar J., Philadelphia; Temple University School of Dentistry, 1926; died May 16; age 57.

Matthies, Charles F., Milwaukee; Marquette University Dental School, 1913; died May 11; age 70.

McClung, Earl P., Muncie, Ind.; Indiana Dental College, 1904; died April 4; age 75.

McCole, Patrick, Chevy Chase, Md.; Georgetown University School of Dentistry, 1917; died May 31; age 67.

McFarland, William H., New London, Mo.; Washington University School of Dentistry, St. Louis, 1908; died April 6; age 75.

McGeehan, Thomas J., Hazelton, Pa.; Temple University School of Dentistry, 1927; died May 24; age 55.

McGourty, Frederick W., Worcester, Mass.; Tufts College Dental School, 1904; died April 7; age 75.

McKenzie, Al Frederick, Bloomington, Ill.; Northwestern University Dental School, 1913; died April 1; age 80.

McKim, Joseph M., La Plata, Mo.; Barnes Dental College, 1905; died February 13; age 75.

McLean, Merton G., San Diego, Calif.; Philadelphia Dental College, 1902; died May 27; age 73.

Mellor, Howard E., Philadelphia; Pennsylvania College of Dental Surgery, 1895; died December 31; age 83.

Messenger, Clifford C., Williamston, Mich.; Detroit College of Medicine, Department of Dental Surgery, 1898; died February 12; age 83.

Miller, Daniel R., Bird Island, Minn.; University of Minnesota School of Dentistry, 1902; died May 17; age 78.

Miller, Donald H., Elmira, N. Y.; University of Buffalo School of Dentistry, 1922; died June 7; age 58.

Miller, William H., San Antonio, Texas; Northwestern University Dental School, 1915; died March 27; age 64.

Molyneux, Francis H., Rolfe, Iowa; University of Iowa College of Dentistry, 1917; died May 6; age 67.

Moos, Louis C., Minneapolis; University of Minnesota School of Dentistry, 1918; died May 10; age 72.

Morgan, Russell E., Norwalk, Conn.; Philadelphia Dental College, 1901; died May 24; age 82.

Morris, Harry, Jersey City, N. J.; Medico-Chirurgical College of Philadelphia, 1907; died April 21; age 76.

Mortensen, Manuel R., Moline, Ill.; Western Dental College, 1913; died April 5; age 67.

Mosier, Russell B., Meadville, Pa.; University of Pittsburgh School of Dentistry, 1927; died March 30; age 59.

Moskowitz, Louis C., Brooklyn; New York College of Dentistry, 1914; died May 10; age 62.

Muir, Harry D., Fremont, Neb.; Northwestern University Dental School, 1911; died December 30; age 68.

Murphy, Frank J., New London, Wis.; Marquette University Dental School, 1913; died April 28; age 70.

Nelson, Clarence A., Amery, Wis.; University of Minnesota School of Dentistry, 1917; died February 13; age 67.

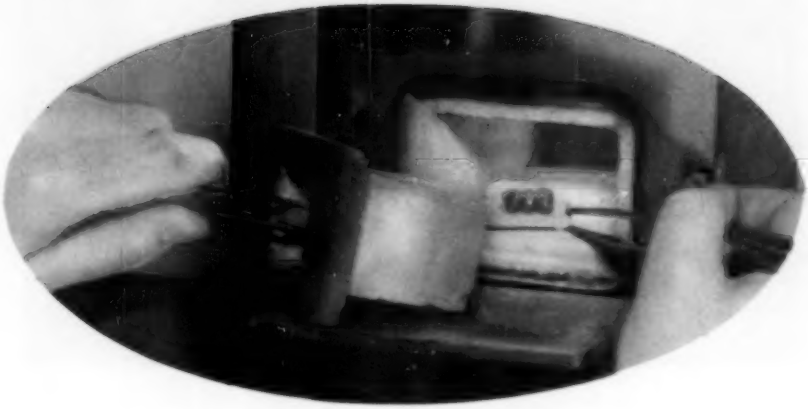
Nesler, Harry C., Dubuque, Iowa; University of Iowa College of Dentistry, 1938; died May 27; age 57.

Newell, John C., Chicago; Northwestern University Dental School, 1915; died May 1; age 66.

Newland, Charles A., Wytheville, Va.; Medical College of Virginia, Dental Department, 1896; died January 15; age 84.

Norton, William E., Cassadaga, Fla.; University of Maryland Dental Department, 1910; died March 27; age 70.

Novak, August, Middle River, Md.; Baltimore College of Dental Surgery, 1915; died April 17; age 70.



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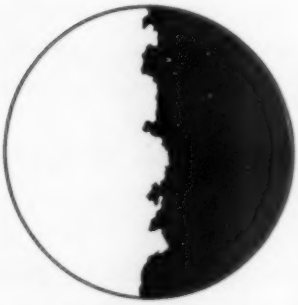

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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION
*222 East Superior Street, Chicago 11, Illinois*
WHitehall 4-6730

LON W. MORREY, *Editor* JOHN E. RUSH, *Business Manager*

All expressions of opinion and statements of supposed fact are published on the authority of the writer over whose signature they appear and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association. Articles are accepted with the understanding that they have not been published previously and that they are submitted solely to The Journal. The Journal of the American Dental Association is indexed in the Index to Dental Literature, in the Current List of Medical Literature and, in part, in the Quarterly Cumulative Index Medicus, Biological Abstracts and Chemical Abstracts.

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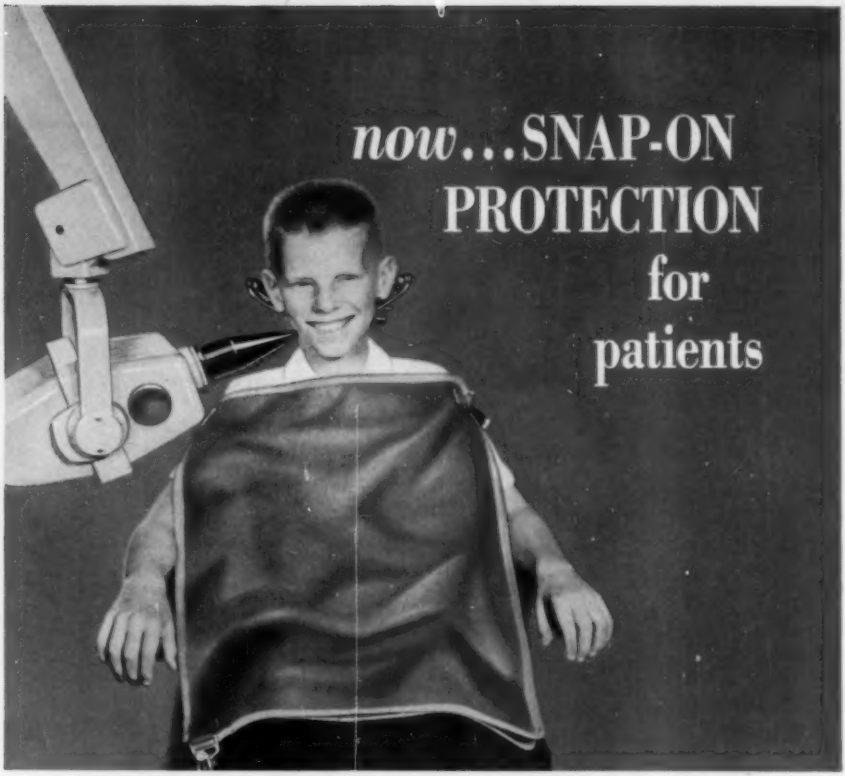
# *Announcements*

## MEETINGS OF THE AMERICAN DENTAL ASSOCIATION

| | | |
|---|---|---|
| Ninety-Ninth Annual Session | November 10-13, 1958 | Dallas, Texas |
| One-Hundredth Annual Session | September 14-18, 1959 | New York |
| One-Hundred and First Annual Session | October 17-20, 1960 | Los Angeles |
| One-Hundred and Second Annual Session | October 16-19, 1961 | Philadelphia |
| One-Hundred and Third Annual Session | October 29-November 1, 1962 | Miami Beach, Fla. |
| One-Hundred and Fourth Annual Session | October 14-17, 1963 | Atlantic City, N. J. |

## MEETINGS OF CONSTITUENT SOCIETIES

| *State* | *Date* | *Place* | *Secretary and Address* |
|---|---|---|---|
| **Alabama** | Apr. 19-22 | Birmingham | C. R. Crook, Professional Center, Montgomery |
| **Alaska** | July 13-15 | Anchorage | C. L. Polley, Box 1896, Juneau |
| **Arizona** | May 6-9 | Scottsdale | W. G. Burke, 15 E. Monroe St., Phoenix |
| **Arkansas** | Apr. 12-15 | Little Rock | D. M. Hamm, Box 89, Clarksville |
| **California** | Apr. 20-22 | San Francisco | W. J. Healy, 518 Sutter St., San Francisco 8 |
| **S. California** | May 4-6 | Los Angeles | S. M. Silverman, 903 Crenshaw Blvd., Los Angeles 19 |
| **Colorado** | | | G. H. Jackson, 724 Republic Bldg., Denver |
| **Connecticut** | May 13, 14 | Hartford | E. S. Arnold, 37 Linnard Rd., W. Hartford |
| **Delaware** | | | E. J. Truono, 1102 S. Broom St., Wilmington 4 |
| **Dist. of Columbia** | Mar. 15-18 | Washington | J. F. Keaveny, 1835 Eye St., N.W., Washington 6 |
| **Florida** | May 17-20 | Hollywood | R. P. Groom, 3127 Atlantic Blvd., Jacksonville |
| **Georgia** | | | F. M. Butler, Jr., Bankers Insurance Bldg., Macon |
| **Hawaii** | June 14-18 | Honolulu | J. H. Dawe, 810 N. Vineyard St., Honolulu |
| **Idaho** | June 22-24 | McCall | J. R. Olesberg, 214 Third St., Coeur d'Alene |
| **Illinois** | May 11-13 | Peoria | P. W. Clopper, 632 Jefferson Bldg., Peoria |
| **Indiana** | May 18-20 | Indianapolis | W. R. Shoemaker, Citizens Bank Bldg., Anderson |
| **Iowa** | May 3-6 | | H. N. Hake, 639 Insurance Exchange Bldg., Des Moines |
| **Kansas** | Apr. 26-29 | Topeka | F. A. Richmond, Brotherhood Bldg., Kansas City 1 |
| **Kentucky** | Apr. 5-8 | Louisville | A. B. Coxwell, Jr., 2208 Dundee Rd., Louisville 5 |
| **Louisiana** | Apr. 1-4 | Shreveport | J. S. Bernhard, 2515 Line Ave., Shreveport |
| **Maine** | June 18-20 | Rockland | S. M. Gower, Box 27, Skowhegan |
| **Maryland** | May 3-6 | Baltimore | C. L. Inman, Jr., Medical Arts Bldg., Baltimore |
| **Massachusetts** | May 3-6 | Boston | H. E. Tingley, 12 Bay State Rd., Boston 15 |
| **Michigan** | Apr. 20-22 | Grand Rapids | F. Wertheimer, Michigan Dept. of Health, Lansing |
| **Minnesota** | Apr. 13-15 | Minneapolis | C. V. E. Cassel, 2236 Marshall Ave., St. Paul 4 |
| **Mississippi** | | | B. A. Cohen, Box 9981, Jackson 27 |
| **Missouri** | May 10-13 | Springfield | E. D. Suggett, Merchants Bank Bldg., Jefferson City |
| **Montana** | May 7-9 | Kalispell | R. C. Ritter, 28 N. Black St., Bozeman |
| **Nebraska** | Apr. 26-29 | Lincoln | F. A. Pierson, Federal Securities Bldg., Lincoln |
| **Nevada** | May 10-12 | Las Vegas | O. M. Seifert, 755 Ryland Ave., Reno |

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| *State* | *Date* | *Place* | *Secretary and Address* |
|---|---|---|---|
| **New Hampshire** | June 21-24 | Whitefield | F. E. Williams, 814 Elm St., Manchester |
| **New Jersey** | May 12-15 | Atlantic City | J. G. Carr, 407 Cooper St., Camden |
| **New Mexico** | June 7-10 | Santa Fe | W. A. Blueher, 24 Medical Arts Sq., N. E., Albuquerque |
| **New York** | May 10-13 | Syracuse | C. A. Wilkie, 1 Hanson Pl., Brooklyn 17 |
| **North Carolina** | May 3-6 | Pinehurst | L. H. Butler, Jefferson Bldg., Greensboro |
| **North Dakota** | May 3-6 | Grand Forks | J. H. Pfister, 419½ Dakota Ave., Wahpeton |
| **Ohio** | | | E. G. Jones, 185 E. State St., Columbus |
| **Oklahoma** | Apr.26-29 | Tulsa | L. D. Wright, Osler Bldg., Oklahoma City |
| **Oregon** | Mar.2-4 | Portland | T. D. Holder, Selling Bldg., Portland |
| **Panama C. Z.** | | | G. E. Lilly, Box 29, Ft. Clayton |
| **Pennsylvania** | May 13-16 | Harrisburg | M. D. Zimmerman, 217 State St., Harrisburg |
| **Puerto Rico** | Jan. | San Juan | J. E. Munos, Box 9023, Santurce |
| **Rhode Island** | Jan. 20, 21 | Providence | H. A. McGuirl, Union Trust Bldg., Providence |
| **South Carolina** | May 24-26 | Charleston | J. E. Wallace, 1506 Gregg St., Columbia |
| **South Dakota** | May 31-June 2 | Rapid City | R. E. Decker, Box 308, Parker |
| **Tennessee** | May 11-14 | Nashville | K. P. Ezell, 116 N. Academy, Murfreesboro |
| **Texas** | May 3-6 | San Antonio | C. A. McMurray, 3707 Gaston Ave., Dallas 10 |
| **Utah** | | | R. C. Dalgleish, State Capitol Bldg., Salt Lake City |
| **Vermont** | | | E. C. Woods, 36 Washington St., Rutland |
| **Virginia** | Apr. 8-11 | Roanoke | W. T. McAfee, Colonial National Bank Bldg., Roanoke |
| **Washington** | Apr. 6-8 | Seattle | G. D. Dore, Jr., 211 Medical Dental Bldg., Seattle 1 |
| **West Virginia** | | | G. N. Casto, Jr., 710½ Lee St., Charleston |
| **Wisconsin** | Apr. 27-29 | Milwaukee | C. J. Baumann, Jr., 606 W. Wisconsin Ave., Milwaukee |
| **Wyoming** | | | T. J. Drew, State Office Bldg., Cheyenne |

## MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

| *State* | *Date* | *Place* | *Secretary and Address* |
|---|---|---|---|
| **Alabama** | June 21-27‡ | | W. L. Smith, 524 Chestnut St., Gadsden |
| **Alaska** | July 7-10*† | Anchorage | R. H. Williams, Box 2122, Juneau |
| **Arizona** | June 15‡ | | W. G. Biddulph, 1611 N. Second Ave., Glendale |
| **Arkansas** | June 15-19 | Little Rock | G. Cone, 113 S. Pecan St., Osceola |
| **California** | Feb. 2<br>June 22<br>July 27<br>August 31 | Los Angeles<br>Los Angeles<br>San Francisco<br>San Francisco | D. R. Grant, 507 Polk St., San Francisco |
| **Colorado** | June 21-27 | Denver | R. F. Gilmore, Republic Bldg., Denver 2 |
| **Connecticut** | | | C. G. Brooks, 302 State St., New London |
| **Delaware** | | | J. F. Maguire, 1200 N. Van Buren St., Wilmington |
| **Dist. of Columbia** | | | W. T. Birthright, 1835 Eye St., N.W., Washington |
| **Florida** | July 5-16*‡<br>July 6, 7†‡ | | R. P. Taylor, Jr., P. O. Box 2913, Jacksonville 3 |
| **Georgia** | June 8-10*† | Atlanta | W. G. Brown, Blackshear |
| **Hawaii** | Feb. 19-23 | Honolulu | J. Y. Ing, James Campbell Bldg., Honolulu |
| **Idaho** | | | W. M. Smith, 305 Fort St., Boise |
| **Illinois** | Nov. 18-21 | | W. A. McKee, Wood Bldg., Benton |
| **Indiana** | Dec. 8-11*† | Indianapolis | C. A. Frech, Gray National Bank Bldg., Gary |
| **Iowa** | June 1-5*† | Iowa City | P. A. Hahn, Farmers & Merchants Bank Bldg., Burlington |
| **Kansas** | | | G. L. Teall, Box 71, Hiawatha |
| **Kentucky** | | | J. J. Kelly, 102 W. Madison St., Franklin |
| **Louisiana** | | | A. R. deNux, Marksville |
| **Maine** | | | A. S. Appleby, Box 260, Skowhegan |
| **Maryland** | | | W. D. Burton, 829 Park Ave., Baltimore 1 |
| **Massachusetts** | | | C. R. Williams, 70 Washington St., Salem |

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|---|---|---|---|
| **Michigan** | Jan. 18-24*† June 7-13*† | Ann Arbor | J. L. Champagne, 3714 McNichols Rd., Detroit 21 |
| **Minnesota** | | | E. A. Nelson, 2236 Marshall Ave., St. Paul 4 W |
| **Mississippi** | Jan. 5-7*†‡ | | A. H. Richter, Jr., Aven Bldg., Greenwood |
| **Missouri** | | | R. R. Rhoades, Central Trust Bldg., Jefferson City |
| **Montana** | | | R. O. Betzner, 303 Power Block, Helena |
| **Nebraska** | | | H. E. Weber, Stuart Bldg., Lincoln |
| **Nevada** | Dec. 7 | Reno | R. Whitehead, 40 W. First St., Reno |
| **New Hampshire** | | | S. G. Markos, 8 Renaud Ave., Dover |
| **New Jersey** | Dec. 1, 2* Dec. 3* Dec. 2† | Philadelphia Trenton Philadelphia | C. J. Schweikhardt, 150 E. State St., Trenton |
| **New Mexico** | | | G. D. Hastain, Box 1007, Clovis |
| **New York** | Dec. 2-5, 8, 9*‡ | | D. W. Beier, 23 S. Pearl St., Albany 7 |
| **North Carolina** | June 22*† | Chapel Hill | J. H. Guion, Doctors Bldg., Charlotte 7 |
| **North Dakota** | July 13-17 | Fargo | G. F. Wirtz, Clinic Bldg., Mandan |
| **Ohio** | | | D. E. Bowers, 322 E. State St., Columbus 15 |
| **Oklahoma** | Dec. 28-30* Dec. 28, 30† | Oklahoma City | W. H. Stephens, Plaza Court Bldg., Oklahoma City |
| **Oregon** | Dec. 8-11*† | Portland | F. L. Utter, Pioneer Trust Bldg., Salem |
| **Pennsylvania** | | | P. Swanson, 8111 Jenkins Arcade, Pittsburgh |
| **Puerto Rico** | | | J. Mercado C., Comercio St. #452, San Juan |
| **Rhode Island** | | | F. M. Hackett, 267 Academy Ave., Providence |
| **South Carolina** | | | W. J. Brockington, 1508 Washington St., Columbia 1 |
| **South Dakota** | | | H. T. Aker, Canton |
| **Tennessee** | Dec. 15‡ | | C. R. Aita, Bennie-Dillon Bldg., Nashville |
| **Texas** | | | R. T. Weber, Capital National Bank Bldg., Austin 16 |
| **Utah** | June 22-27‡ | | R. W. Fishburn, 4 Professional Center, Brigham City |
| **Vermont** | June 22-24‡ | | P. M. Fitch, Newport |
| **Virginia** | June 8-13* June 10, 11† | Richmond | J. M. Hughes, Medical Arts Bldg., Richmond |
| **Washington** | | | F. S. Rotchford, 1108 S. Washington St., Olympia |
| **West Virginia** | June 22-24‡ | | C. C. Cottrill, Box 111, Glen Rogers |
| **Wisconsin** | | | S. F. Donovan, Tomah |
| **Wyoming** | | | E. E. Edwards, Bank of Commerce Bldg., Sheridan |

**Dental examination. †Dental hygiene examination. ‡Write to secretary of dental examining board for information on locations of examinations. Most states require applications to be in 30 days prior to examination date.*

## MEETINGS OF OTHER ORGANIZATIONS

| *Name* | *Date* | *Place* | *Secretary or Chairman and Address* |
|---|---|---|---|
| **Academy of Dentistry for the Handicapped** | Feb. 8 | Chicago | R. Kaplan, 3038 Federal St., Camden, N.J. |
| **Academy of Denture Prosthetics** | Apr. 12-17 | Louisville, Ky. | W. L. Warburton, Medical Arts Bldg., Salt Lake City 11 |
| **All India Dental Conference (Twenty-fourth)** | Feb. 19 | Bangalore | R. S. Padmanabhan, 29 Vanivilas Road, Basavangudi, Bangalore 4, India |
| **American Academy of Crown and Bridge Prosthodontics** | Feb. 7, 8 | Chicago | W. E. Corry, 2165 Adelbert Rd., Cleveland 6 |
| **American Academy of Dental Medicine** | Dec. 7 | New York | W. I. Levine, 809 Cathedral St., Baltimore, Md. |
| **American Academy of Dental Practice Administration** | Feb. 5, 6 | Chicago | R. H. Campbell, 18595 Grand River Ave., Detroit 23 |
| **American Academy of Gold Foil Operators** | Nov. 7, 8 | Dallas | C. C. Latham, 1125 Tenth St., Coronado, Calif. |
| **American Academy of the History of Dentistry** | Nov. 7 | Dallas | M. B. Asbell, 25 Haddon Ave., Camden, N.J. |

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|---|---|---|---|
| **American Academy of Implant Dentures** | Nov. 7-9 | Dallas | A. N. Cranin, 2120 Ocean Ave., Brooklyn 29 |
| **American Academy of Maxillofacial Prosthetics** | Feb. 4-6 | Chicago | H. C. Sullivan, 1516 Wealthy St., S.E., Grand Rapids 6, Mich. |
| **American Academy of Oral Pathology** | Apr. 17-19 | Minneapolis | R. J. Gorlin, School of Dentistry, University of Minnesota, Minneapolis 14 |
| **American Academy of Oral Roentgenology** | Nov. 7, 8 | Dallas | T. S. Grant, 508 16th St., Oakland, Calif. |
| **American Academy of Periodontology** | Nov. 6-8 | Dallas | C. E. Chamberlain, 1101 N. North St., Peoria, Ill. |
| **American Academy of Restorative Dentistry** | Feb. 7, 8 | Chicago | M. H. Mortonson, Jr., 735 N. Water St., Milwaukee 2 |
| **American Association for the Advancement of Science, Section on Dentistry** | Dec. 29 | Washington, D.C. | R. W. Bunting, University of Michigan, School of Dentistry, Ann Arbor, Mich. |
| **American Association for Cleft Palate Rehabilitation** | Apr. 30-May 2 | Philadelphia | D. C. Spriestersbach, Dept. of Otolaryngology, University Hospitals, Iowa City, Iowa |
| **American Association of Dental Editors** | Nov. 8 | Dallas | A. H. Kutscher, 400 N. 8th Ave., Highland Park, N.J. |
| **American Association of Dental Examiners** | Nov. 7, 8 | Dallas | G. L. Teall, Box 71, Hiawatha, Kan. |
| **American Association of Dental Schools** | Nov. 9 | Dallas | M. W. McCrea, School of Dentistry, University of Minnesota, 127 Owre Hall, Minneapolis |
| **American Association of Endodontists** | Feb. 6-8 | Chicago | V. B. Milas, 2559 W. 63rd St., Chicago 29 |
| **American Association of Industrial Dentists** | Apr. | Chicago | E. R. Aston, Pennsylvania Dept. of Health, P.O. Box 90, Harrisburg, Pa. |
| **American Association of Orthodontists** | May 4-7 | Detroit | E. E. Shepard, 8230 Forsyth Blvd., St. Louis |
| **American Association of Public Health Dentists** | Nov. 8 | Dallas | P. Ayres, Box 2591, Jefferson County Dept. of Health, Birmingham, Ala. |
| **American Board of Dental Public Health** | Nov. 6, 7 | Dallas | C. V. Tossy, Michigan Dept. of Health, Lansing, Mich. |
| **American Board of Oral Pathology** | Dec. 6, 7 | | D. A. Kerr, University of Michigan, School of Dentistry, Ann Arbor, Mich. |
| **American Board of Oral Surgery** | Dec. 1<br>Apr. 2-6 | Chicago<br>Chicago | L. M. FitzGerald, Roshek Bldg., Dubuque, Iowa |
| **American College of Dentists** | Nov. 9 | Dallas | O. W. Brandhorst, 4221 Lindell Blvd., St. Louis |
| **American Dental Assistants Association** | Nov. 10-13 | Dallas | M. L. Martin, First National Bank Bldg., La Porte, Ind. |
| **American Dental Hygienists' Association** | Nov. 10-13 | Dallas | M. E. Swanson, 100 E. Ohio St., Chicago |
| **American Dental Society of Anesthesiology** | Nov. 8, 9 | Dallas | H. A. Sultz, 249 Linwood Ave., Buffalo |
| **American Denture Society** | Nov. 7, 8 | Dallas | V. L. Steffel, College of Dentistry, Ohio State University, Columbus, Ohio |
| **American Society of Dentistry for Children** | Nov. 7-9 | Dallas | R. E. McDonald, School of Dentistry, Indiana University, 1121 W. Michigan St., Indianapolis |
| **Armed Forces Reserve Dental Officers' Association** | Nov. 9 | Dallas | D. Lewis, 11601 Viers Mill Rd., Wheaton, Md. |
| **Association of American Women Dentists** | Nov. 10 | Dallas | M. B. McCann, 2600 N. McCullough, San Antonio, Texas |
| **Australian Dental Congress (Fifteenth)** | Feb. 23-27 | Adelaide, So. Australia | M. J. Barrett, 51 Grenfell St., Adelaide, So. Australia |
| **British Dental Association** | May 25-29 | Torquay, England | Secretary, British Dental Association, 13 Hill St. Berkeley Square, London W. 1 |
| **Canadian Dental Association** | June 21-24 | Halifax | D. W. Gullett, 234 St. George St., Toronto 5, Canada |
| **Central Dental Association** | Jan. 18-21 | Whitefish, Mont. | R. E. Baker, Lowry Bldg., St. Paul 2 |
| **Chicago Dental Society** | Feb. 8-11 | Chicago | K. S. Richardson, 30 N. Michigan Ave., Chicago |
| **Council on Dental Education, Dental Aptitude Tests** | Jan. 9, 10<br>Apr. 17, 18 | | S. Peterson, 222 E. Superior St., Chicago 11 |

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| **Cuban National Dental Congress (Fifth)** | Mar. 29-31 | Havana | C. Funcia C., No. 353, Vedado, Havana, Cuba |
| **Dallas Mid-Winter Dental Clinic (Thirty-second)** | Jan. 25-28 | Dallas, Texas | M. Thornton, 2921 Fairmount, Dallas, Texas |
| **Denver Dental Association** | Jan. 11-14 | Denver | W. D. McCarthy, Republic Bldg., Denver 2 |
| **Detroit District Dental Society** | Nov. 24, 25 | Detroit | S. Silverman, 6426 Van Dyke Ave., Detroit 13 |
| **Florida East Coast Dental Society** | Jan. 9, 10 | Miami, Fla. | A. Linsner, 2 S.E. 13th St., Miami 32, Fla. |
| **Greater New York Dental Meeting (Thirty-fourth)** | Dec. 8-12 | New York | M. Purdy, Statler Hotel, New York 1 |
| **Greater Philadelphia** | Mar. 3-6 | Philadelphia | M. Kohn, Sheraton Hotel, 17th St. and Pennsylvania Blvd., Philadelphia 3 |
| **International Association for Dental Research** | Mar. 19-22 | San Francisco | D. Y. Burrill, Northwestern University, 311 E. Chicago Ave., Chicago 11 |
| **International College of Dentists** | Nov. 9 | Dallas | H. O. Westerdahl, 4829 Minnetonka Blvd., Minneapolis |
| **International Dental Congress of Chile (Fourth)** | Nov. 16-22 | Santiago, Chile | J. C. Montandon, Sociedad Odontologica de Chile, Casilla 2575, Santiago, Chile |
| **International Dental Meeting of Paris (Thirty-second)** | Nov. 24-30 | Paris, France | R. A. Robert, 10, rue de l'Isly, Paris 8, France |
| **Japan Dental Association** | Mar. | Tokyo, Japan | T. Kashima, 6-4 Kudan Chiyoda-ku, Tokyo |
| **Midwest Society of Periodontology** | Feb. 7, 8 | Chicago | G. Roth, University of Kansas City, School of Dentistry, 1108 E. Tenth St., Kansas City 6, Mo. |
| **Montana, Ninth District Dental Society** | Jan. 15-17 | Billings | C. H. Betzer, 1231 N. 29th St., Billings, Mont. |
| **National Association of Seventh Day Adventist Dentists** | Nov. 7-9 | Dallas | G. H. Curtis, Medical College of Evangelists, Dental School, Loma Linda, Calif. |
| **National Board of Dental Examiners** | Dec. 1, 2 | | G. J. Casey, 222 E. Superior St., Chicago 11 |
| **New Orleans Dental Conference (Eleventh)** | Nov. 23-26 | New Orleans | A. A. Copping, 4704 Paris Ave., New Orleans |
| **Northeastern Society of Orthodontists** | Nov. 3, 4 | Montreal, Canada | D. Mossberg, 36 Central Park S., New York |
| **Odontological Federation of Central America and Panama, Second International Convention** | Nov. 26-29 | San Jose, Costa Rica | R. Chartier, P. O. Box 698, San Jose, Costa Rica C.A. |
| **Pan-American Dental Congress** | Nov. 18-22 | Mexico City, Mex. | R. E. Woodworth, Asociacion Dental Mexicana Sinaloa 9, Mexico 7, D.F. |
| **Pan American Odontological Association** | Dec. 10 | New York | R. H. Brodsky, 14 E. 81st St., New York |
| **Rumanian Stomatological Congress** | Dec. | | N. Herman, Section de Stomatologie de la Societe des Sciences Medicales de la Republique Populaire Roumaine, Str. Progresuliu 6, Bucharest, Rumania |
| **Southeastern Academy of Prosthodontics** | Mar. 13-15 | Atlanta, Ga. | H. C. Parker, Liberty Life Building, Charlotte 2, N.C. |
| **Southeastern Society of Oral Surgeons** | May 7-9 | Gatlinburg, Tenn. | P. B. Whittington, Jr., Medical Arts Bldg., Greensboro, N.C. |
| **Southern Academy of Oral Surgery** | Mar. 14, 15 | Atlanta, Ga. | T. E. Braly, Volunteer Bldg., Chattanooga, Tenn. |
| **Thomas P. Hinman Dental Clinic** | Mar. 15-18 | Atlanta, Ga. | H. W. Wallace, 1193 The By Way, N.E., Atlanta, Ga. |

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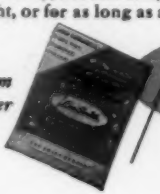

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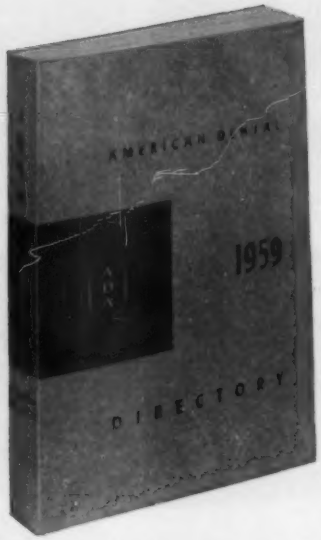


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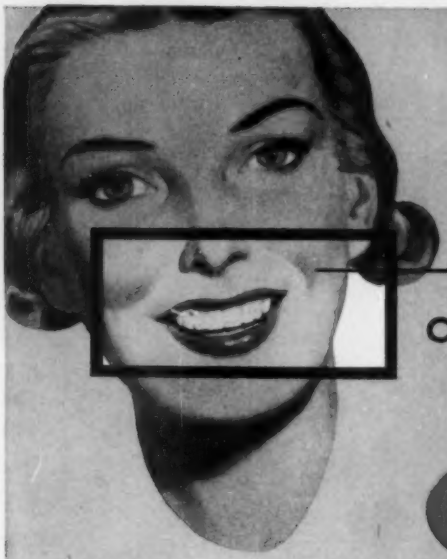

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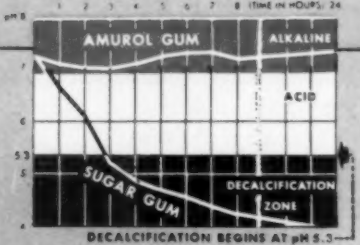


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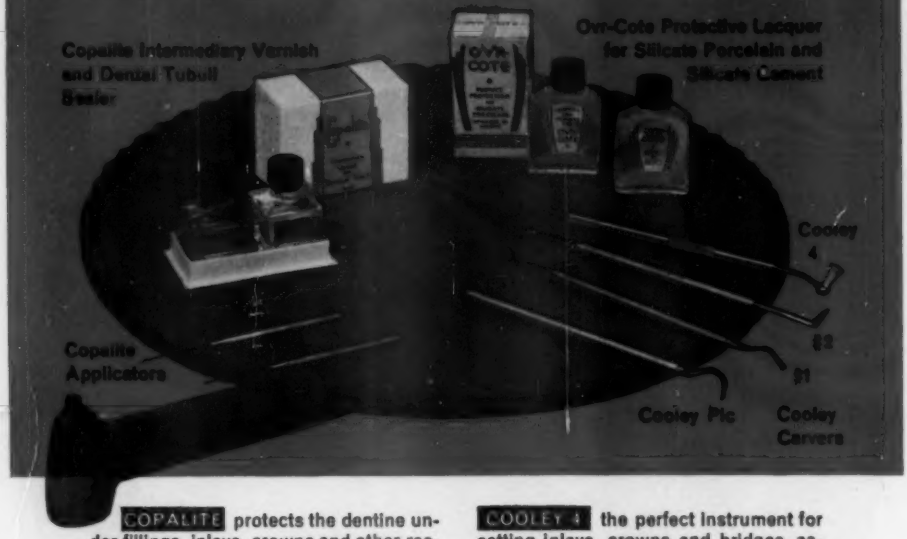


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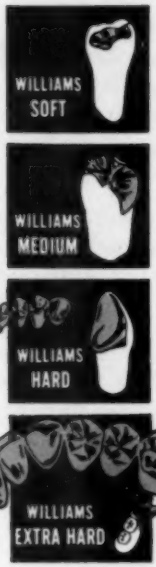


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For these reasons enriched bread has a well-merited place in the diet recommended for maintaining the tissues which invest and support the teeth.

*Nutritionally, today's enriched white bread and whole wheat bread are almost identical. Both make worthwhile contributions to the satisfaction of nutritional needs.*

*Joint Report of the Council on Dental Health and the Council on Dental Therapeutics of the American Dental Association, J. Am. Dent. A. 47:387 (Oct.) 1952.

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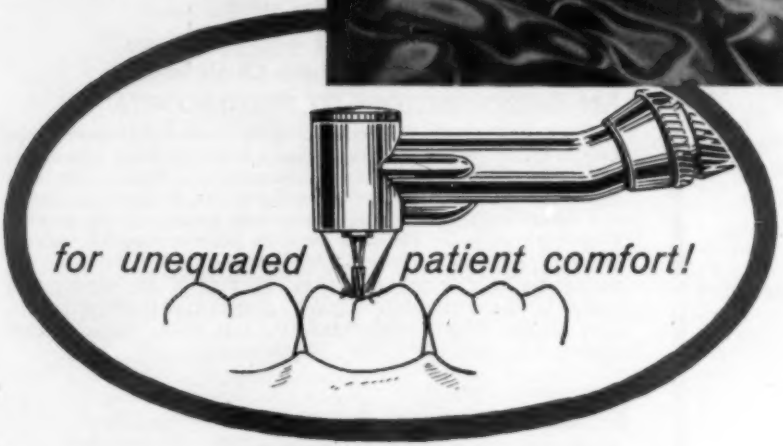


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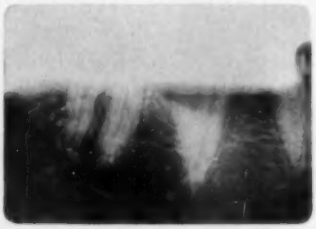

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| 16" Distance | 1/2 | 1/2 | 3/10 | 3/10 | 2/5 | 2/5 | 3/10 | 3/10 |

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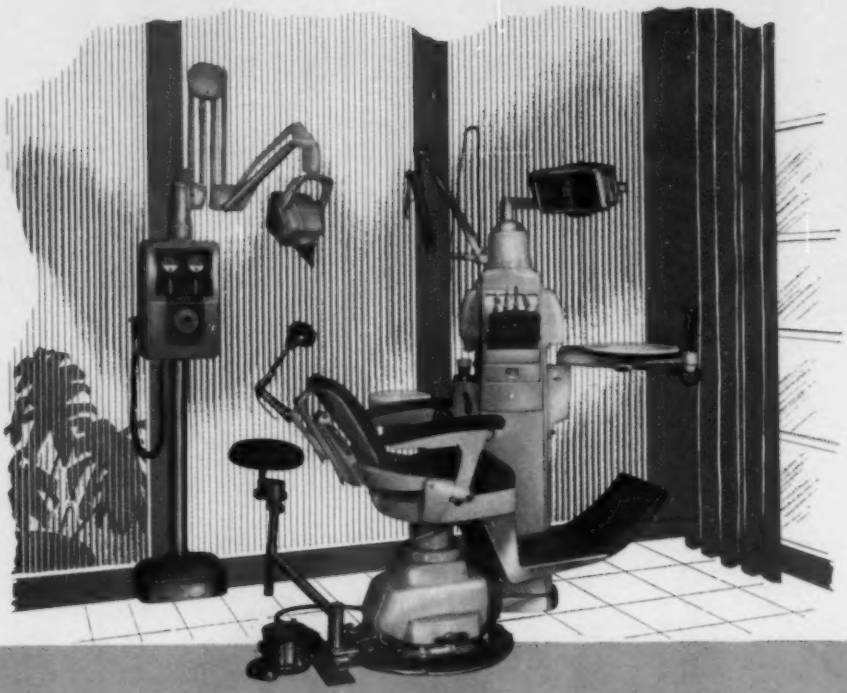

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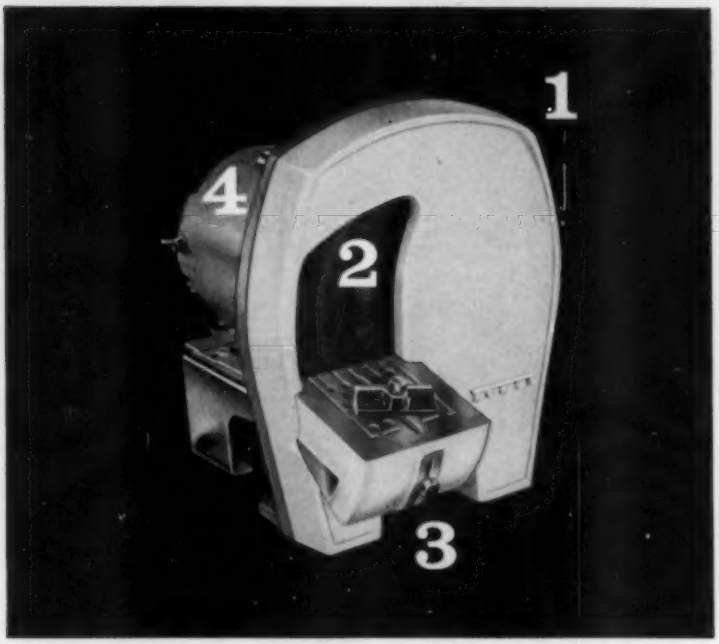


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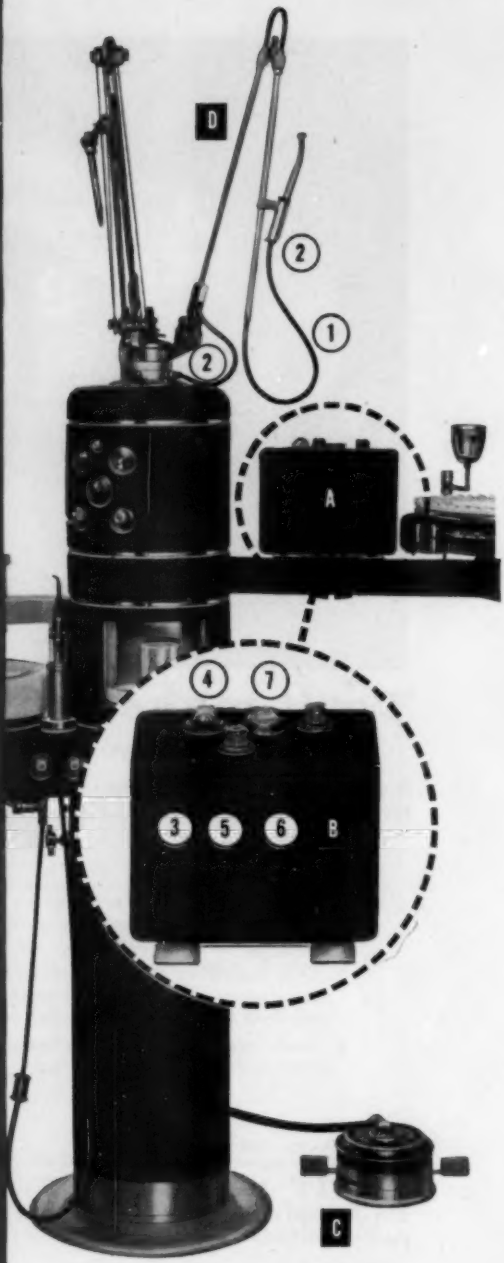
Patients like the quiet, smooth, tension-easing features of this revolutionary precision hand piece. It operates at speeds from 100,000 to 250,000 r.p.m. with variable air pressures . . . and gives you the exclusive advantages listed here. Order now.

THE S. S. WHITE DENTAL MFG. CO.
Philadelphia 5, Pa.



*factory installed units have these additional features*

## Only the S. S. White Airotor gives you all of these features

1. **CONCENTRIC HOSE** Concentric hoses delivering water, air and lubrication to the handpiece head.

2. **QUICK COUPLERS** Quick coupling at both ends of handpiece hose makes it easy to disassemble for checking or servicing handpiece and tubings.

3. **POSITIVE LUBRICATION DEVICE** Exclusive lubrication feature permits operation at air pressure as low as 10 lbs. p.s.i.

4. **VISIBLE LUBRICATOR DOME** Lubrication dome is exposed to permit its performance to be observed or checked without removing the cover.

5. **WATERPROOF COILS** Coils in the Solenoid valve assembly are waterproof, and insure against short circuits.

6. **FILTER FOR POSITIVE AIR FILTRATION** Air filter removes all particles more than 10 microns in size.

7. **EXPOSED AIR GAUGE** Exposed gauge for quick checking of air pressure and more accurate speed control.

---

**A** Airotor control box styled to better match the unit design and finished in the color of the unit.

**B** Automatically activated purging valve on the air filter eliminates the need for operator's attention.

**C** Single foot control for both Airotor and standard handpiece. A dome switch permits operator to activate either instrument.

**D** Double section arm and hanger eliminates dangling tubing and positions the Airotor handpiece in a more accessible location.

*(Double section arm and dual support shown are optional items)*

# PROVEN IN PRACTICE

COOK-WAITE LABORATORIES, INC., 1450 BROADWAY, NEW YORK 18, N. Y.

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Brand of propoxycaine HCl — Brand of procaine HCl
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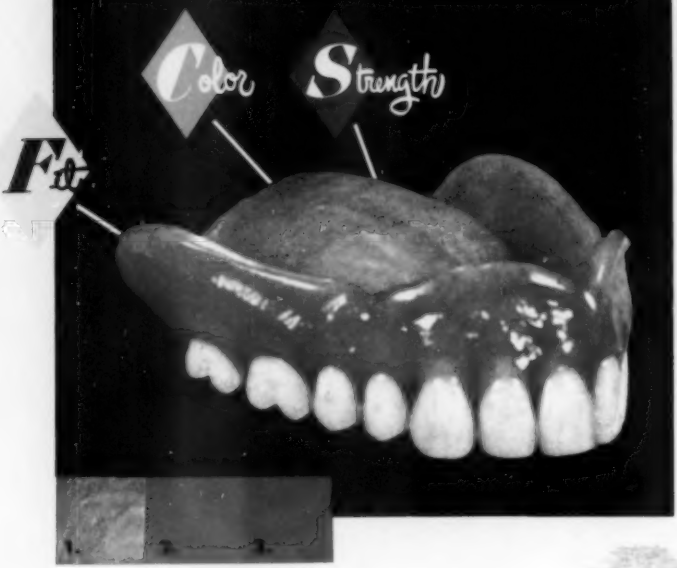
Dentistry's most talked about denture material!

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Every Tilon denture has all 3 FIT - COLOR - STRENGTH because every Tilon denture is cured by the amazing "Unidirectional" curing technique — exclusive with Tilon.

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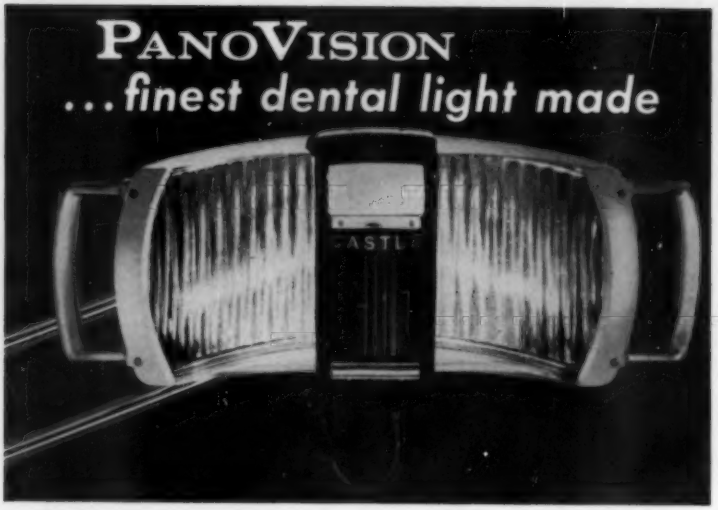


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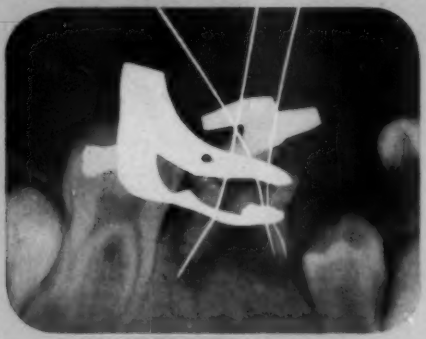
4/1/57 Before treatment—age nine years.

# EXPERIMENTAL ROOT CANAL FILLING

**of infected lower second primary molar with no permanent successor.**



4/11/57 After extirpation of pulp tissue; measured guide wires in place.

4/19/57 Shows two posterior canals filled with silver wires.

# Better film coverage *with*

**THE GOAL TODAY** is to get maximum information with minimum radiation; to hold each exposure to the lowest practical level; to avoid retakes.

These aims place extra emphasis upon film speed and quality. That is why today so many dentists are specifying Kodak dental x-ray materials—faster dental x-ray film, better dental x-ray chemicals . . . *made to work together* . . . made to produce uniform, dependable results . . . *when used together.*

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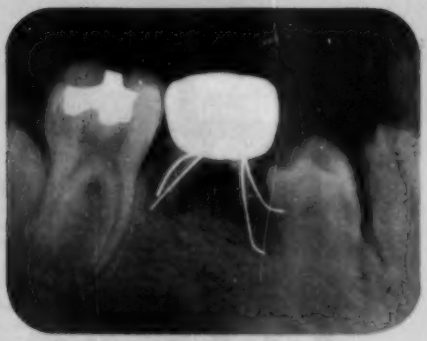

10/20/57 Shows cast crown restoration. Note improved alveolar bone, and bending of anterior wires.

5/29/57 Shows all four canals filled.

3/17/58 Later follow-up radiograph.

# fewer examinations

**FOR *MORE* INFORMATION . . . *LESS* RADIATION . . .**

To reduce radiation reaching the patient and operator; to assure better radiographs, less "blurring" from movement . . .

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for admission to 1959 Dental School Classes will be given on

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*(application must be received by December 22)*

**APRIL 17 or 18, 1959**

*(application must be received by April 3)*

Sponsored by Council on Dental Education of the American Dental Association

Applicants may contact any of the dental schools listed for a copy of the brochure, THE 1959 DENTAL APTITUDE TESTING PROGRAM, and for the application blank to take the tests.

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Birmingham 3, Alabama

**CALIFORNIA**
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College of Physicians and Surgeons
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San Francisco 3, California

School of Dentistry
University of California
University Medical Center
San Francisco 22, California

School of Dentistry
University of Southern California
925 West Thirty-fourth Street
Los Angeles 7, California

School of Dentistry
College of Medical Evangelists
Loma Linda, California

**DIST. OF COLUMBIA**
School of Dentistry
Georgetown University
3900 Reservoir Road, N. W.
Washington 7, D. C.

College of Dentistry
Howard University
600 W. Street, N. W.
Washington 1, D. C.

**GEORGIA**
School of Dentistry
Atlanta-Southern Dental College
Emory University
106 Forrest Avenue, N.E.
Atlanta 3, Georgia

**ILLINOIS**
Chicago College of Dental Surgery
Loyola University
1757 West Harrison Street
Chicago 12, Illinois

The Dental School
Northwestern University
311 East Chicago Avenue
Chicago 11, Illinois

College of Dentistry
University of Illinois
808 South Wood Street
Chicago 12, Illinois

**INDIANA**
School of Dentistry
Indiana University
1121 West Michigan Street
Indianapolis 2, Indiana

**IOWA**
College of Dentistry
State University of Iowa
Dental Building
Iowa City, Iowa

**KENTUCKY**
School of Dentistry
University of Louisville
129 East Broadway
Louisville 2, Kentucky

**LOUISIANA**
School of Dentistry
Loyola University
6363 St. Charles Avenue
New Orleans 18, Louisiana

**MARYLAND**
Baltimore College of Dental Surgery
The Dental School
University of Maryland
618 West Lombard Street
Baltimore 1, Maryland

**MASSACHUSETTS**
Harvard School of Dental Medicine
25 Shattuck Street
Boston, 15, Massachusetts

School of Dental Medicine
Tufts University
136 Harrison Avenue
Boston 11, Massachusetts

**MICHIGAN**
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University of Detroit
630 East Jefferson Avenue
Detroit 26, Michigan

School of Dentistry
University of Michigan
Ann Arbor, Michigan

**MINNESOTA**
School of Dentistry
University of Minnesota
Washington Ave. and Union St., S.E.
Minneapolis 14, Minnesota

**MISSOURI**
Kansas City-Western Dental College
School of Dentistry
The University of Kansas City
1108 East Tenth Street
Kansas City 6, Missouri

School of Dentistry
St. Louis University
3556 Caroline Street
St. Louis 4, Missouri

School of Dentistry
Washington University
4559 Scott Avenue
St. Louis 10, Missouri

**NEBRASKA**
School of Dentistry
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26th and California Streets
Omaha 2, Nebraska

College of Dentistry
University of Nebraska
Lincoln 8, Nebraska

**NEW JERSEY**
School of Dentistry
Farleigh Dickinson University
Teaneck, New Jersey

College of Dentistry
Seton Hall University
Jersey City Medical Center
Jersey City, New Jersey

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School of Dental and Oral Surgery
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New York 32, New York

College of Dentistry
New York University
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New York 10, New York

School of Dentistry
University of Buffalo
3435 Main Street
Buffalo 14, New York

**NORTH CAROLINA**
School of Dentistry
The University of North Carolina
Chapel Hill, North Carolina

**OHIO**
College of Dentistry
The Ohio State University
Columbus 10, Ohio

School of Dentistry
Western Reserve University
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Cleveland 6, Ohio

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Thomas W. Evans Museum & Dental
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University of Pennsylvania
4001 Spruce Street
Philadelphia 4, Pennsylvania

School of Dentistry
University of Pittsburgh
Thackeray and O'Hara Streets
Pittsburgh 13, Pennsylvania

**TENNESSEE**
School of Dentistry
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Nashville 8, Tennessee

College of Dentistry
University of Tennessee
847 Monroe Avenue
Memphis 3, Tennessee

**TEXAS**
College of Dentistry
Baylor University
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Dallas 10, Texas

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Dental Branch
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**VIRGINIA**
School of Dentistry
Medical College of Virginia
12th and Clay Streets
Richmond 19, Virginia

**WASHINGTON**
School of Dentistry
University of Washington
Health Sciences Building
Seattle 5, Washington

**WEST VIRGINIA**
School of Dentistry
West Virginia University
Morgantown, West Virginia

**WISCONSIN**
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Marquette University
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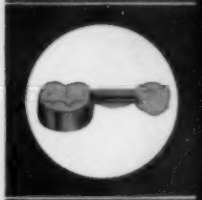
The dental aptitude tests are administered in 50 other colleges and universities located in the United States, Alaska, England, Germany, Hawaii, Japan, Korea, and Puerto Rico.



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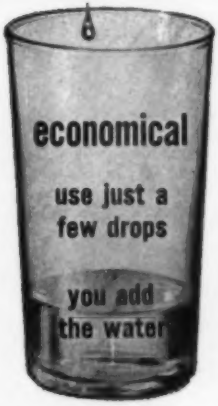


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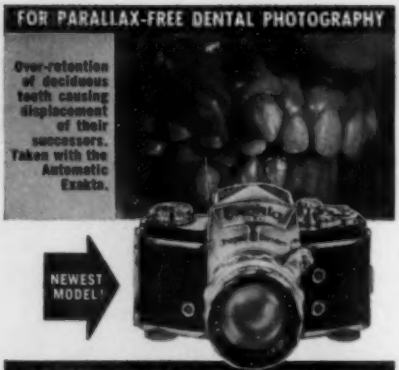
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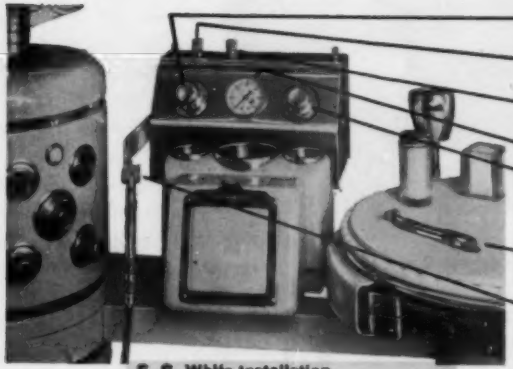

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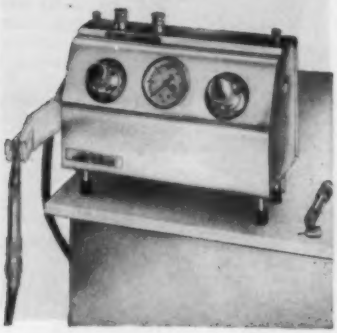

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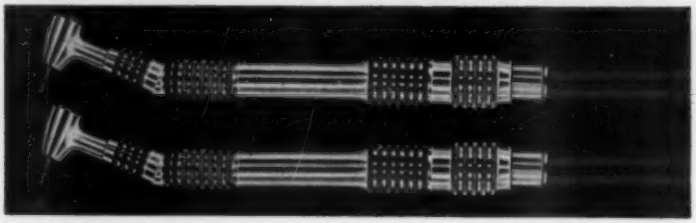

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MONTANA—Wanted. Dentist in town of 2,000 population. Must be licensed to practice in Montana. Farming, ranching and oil producing, northeastern Montana. Excellent gross income assured. Need is urgent as no other practicing dentist for some distance. Office space available. For further particulars please write to Secretary, Chamber of Commerce, Poplar, Mont.

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CALIFORNIA—Oral surgeon, age 32, completing fourth year approved hospital training. Military service completed. California licensed, desires association in California. Address A.D.A. Box No. 234.

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CONNECTICUT—Maryland licensed dentist, National Boards, experienced, age 33, desires position or association. Address A.D.A. Box No. 235.

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District of Columbia licensed, military obligation completed. 1953 Maryland graduate, desires association or part-time work in established practice. Have own equipment, married, age 29. Address A.D.A. Box No. 236.

FLORIDA—1957 Iowa graduate, 27, family. Florida licensed, desires association with oral rehabilitation specialist or general practitioner. Will complete service October 1959. Prefer central Florida. Address A.D.A. Box No. 206.

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Massachusetts licensed, 1956 University of Pennsylvania graduate, 28, desires to purchase practice, associate with option to purchase, or lease space in building or medical center in Massachusetts. Military obligation completed by December 1958. Address A.D.A. Box No. 238.

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Minnesota 1956 graduate, 26, family, desires association or employment with established, ethical general practitioner or group practice. Licensed in Minnesota and Montana. Military obligation recently completed. Address A.D.A. Box No. 239.

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Wisconsin licensed dentist age 42, married, family, 17 years general practice, desires position with government, industry or hospital institution. Experience—four years Army Dental Corps. Will consider foreign service. Address A.D.A. Box No. 244.

Desire overseas position with foreign or domestic industry, government, civil service, school or hospital. Single, 32, completed military obligation. 1953 graduate. Will answer all inquiries. Address A.D.A. Box No. 218.

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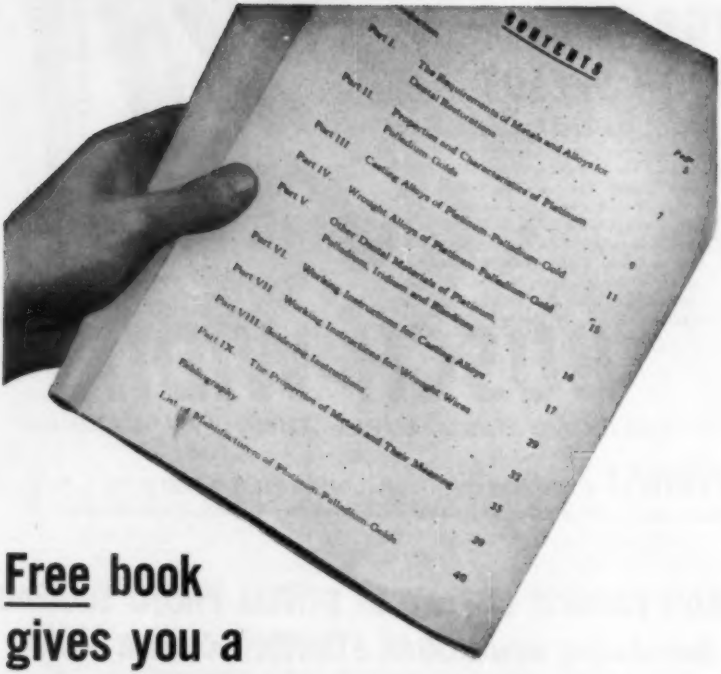
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Part III Casting Alloys of Platinum-Palladium-Gold
Part IV. Wrought Alloys of Platinum-Palladium-Gold
Part V Other Dental Materials of Platinum, Palladium, Iridium and Rhodium
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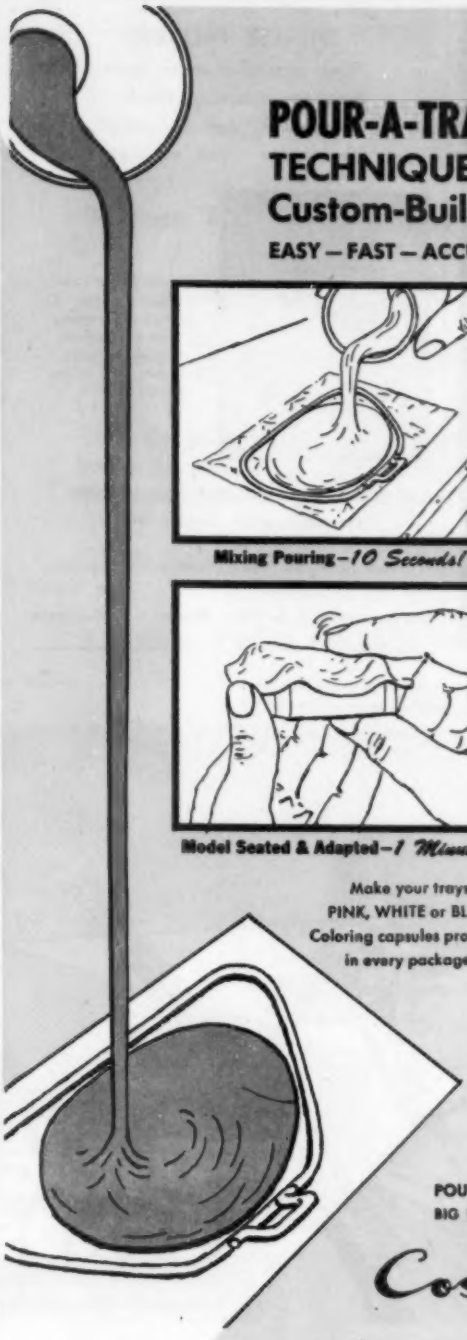

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